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THE CULTIVATION OF PINE-APPLES IN CEYLON.

In the present number of the TROPICAL AGRICULTURIST is reproduced the Bulletin of the Department of Agriculture on the cultivation of Pine-apples.

There have been several enquiries during the past few months as to the possibilities of the cultivation of pine-apples for canning. The pine-apple grows well in Ceylon and yields good crops of fine fruit. These are all sold through the various markets for consumption locally.

The largest pine-apples are grown in the Kegalle district, but better flavoured fruit are procurable from the drier districts.

Pine-apples are grown in small areas in Ceylon, principally in gardens. There are very few large cultivations, systematically and methodically carried on. The largest is probably in the Kegalle district, but even in this very little cultivation is done.

It is therefore impossible to give any accurate data concerning the yields of pine-apples in the Colony. The average appearance of the plants is equal to the average of other tropical countries and the crops appear to be equally as good. Pine-apples appear to suffer but little from pests and diseases and therefore satisfactory crops may be expected.

Pine-apples grow on all classes of soil which are well drained. They are shallow-rooted plants and the spread of the roots is not wide. They can therefore be planted on shallow soils and can be planted comparatively close together. They will not thrive on lands which are badly drained or liable to flooding. A light loam is preferable to a heavy clay.

In Porto Rico, Florida, Hawaii and other countries pine-apples are planted at distances not exceeding eighteen inches apart and experiments with these distances are being made in Ceylon. With this closer planting it is probable that fruits will not be so large but this should not be a disadvantage when fruits are being produced for a cannery. The three-row system of planting is recommended when commercial cultivation of pine-apples is undertaken on a large scale and its trial in Ceylon is worthy of careful consideration.

There are large areas of land available which would be suitable for pine-apple cultivation, and a considerable amount of this is situated within easy access for transport purposes.

There is a possibility that any cannery might most conveniently be situated at Colombo. Labour would be more likely to be available for the rush season of the crop, and the purity of the water required for making the syrup could be guaranteed.

The present cost of machinery for the cannery is high, but prices have been falling during the past few months, and there is reason to believe that the estimate of Rs. 80,000 mentioned in the Bulletin would be found to be adequate. At the present time, every effort is necessary to increase the resources of the Colony, and the possibility of the establishment of pine-apple canning deserves the closest and fullest investigation. It is only by the increase of our economic resources that the future can be faced with equanimity. The fall in the values of money since the war necessitates an increase in economic resources or else a period of stagnation.

There is little doubt that pine-apples can be grown in large areas of the Colony. Whether a cannery can be worked so as to compete with the existing industries of other countries has to be fully investigated by those with a full knowledge of the business.

The prospects appear to be favourable and many consider a canning industry within the realms of practical possibilities.

RUBBER.

BUDDING AND GRAFTING OF RUBBER.

RUBBER RESEARCH SCHEME (CEYLON) CIRCULAR.

The following circular has been issued by the Ceylon Rubber Research Scheme to all its subscribers in the hope that interest will be stimulated in the budding and grafting of rubber. The Scheme is offering a prize to the estate or individual who produces the largest number of budded or grafted rubber plants before December 31st, 1922 :—

Progress has been made in Java in recent years in the budding and grafting of rubber. It is now estimated that there are over 100 acres of budded or grafted rubber growing in Java, and although a conclusive opinion as to the economic value of this method of propagation can only be formed after yields from tapping experiments have been secured. There is little doubt that a fuller investigation into this method of propagating good types of heavy yielding rubber is very necessary in Ceylon.

In Java it has been ascertained that there are certain types which can be isolated and perpetuated by budding or grafting, that the anatomical structure of the scion is for the greater part independent of the number of rows of latex vessels in the stock, that budded plants grow well, and that the number of rows of latex vessels is satisfactory.

It is well-known that plantations of Hevea consist of many bad yielders and a few good ones. Accurate information is being obtained in Java and the Federated Malay States and it is not uncommon to find that 25% of the trees of the plantation are producing 75% of the total crop output.

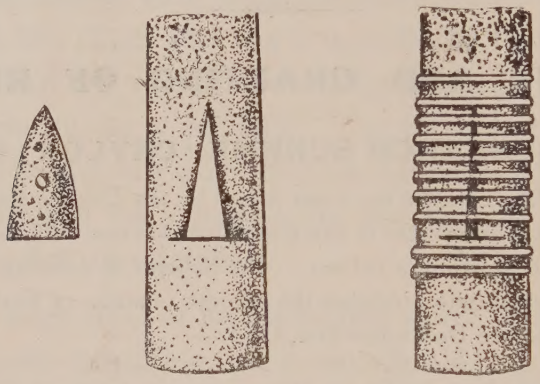
It is important therefore that investigations should be made regarding the economic prospects of budding and grafting.

Considerable difficulty has been experienced in Ceylon in the attempts made to secure budded or grafted plants, and it is hoped that further attempts will be made upon estates. The Rubber Research Scheme is desirous of encouraging the attempts as far as possible.

In Java the most successful budding or grafting is limited to about three months of the year. These are the months when there is a good flow of sap, for at these times the bark more readily comes away from the wood. In Ceylon, the times most suitable for budding and grafting will vary in the different districts but will probably be shortly after wintering and also when new leaves are being put out and growth is being made after rains.

The following methods of budding have been experimented with in Java :—

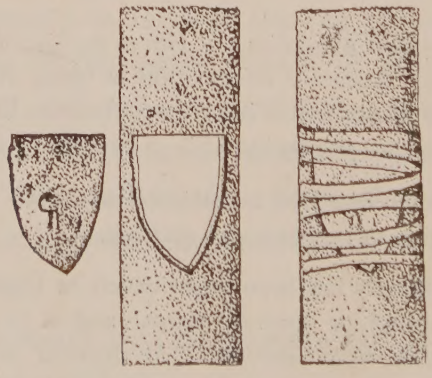
1. The inverted T method of budding :—



This is the method usually employed in the budding of roses.

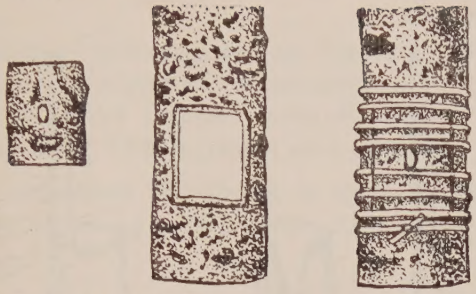
The method employed is to remove a piece of bark with bud required to be inserted into the stock and then to remove carefully the small portion of wood taken with the bark. In the bark of the stock into which the bud is to be inserted an incision in the form of an inverted T is made. The bark is then raised and the bud is gently pushed into the opening. It should be bound with waxed tape leaving only the tip of the bud exposed. At Peradeniya it appears that complete covering of the inserted bud for a few days may be desirable.

2. Bud-grafting :—



In this case a triangular piece of bark containing a bud is transferred into a stem from which a similarly shaped piece of bark has been removed. A small quantity of grafting wax is then smeared over the edges of contact and the bark then tied firmly with budding tape or strands of bark. After this the whole should be covered with strips of cloth dipped in melted paraffin wax, as a further preventive against the admission of air and moisture. It is necessary that the bud should fit accurately the incision in the stock.

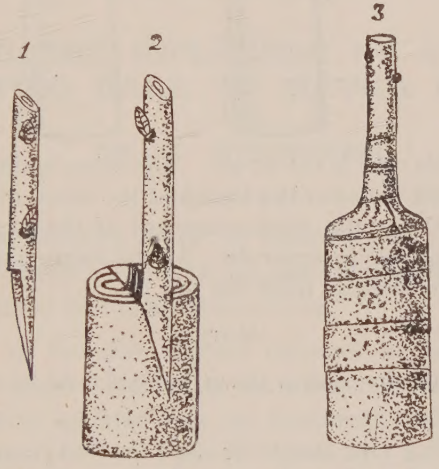
3. Patch budding :—



This method is similar to 2 except that a slightly larger rectangular piece of bark is transferred.

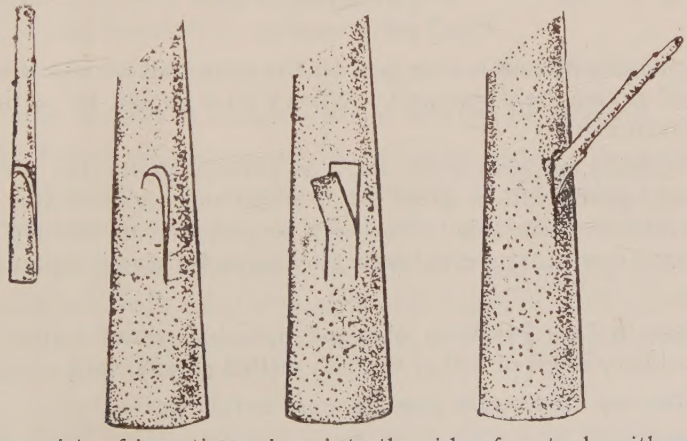
GRAFTING.

1. Cleft grafting :—



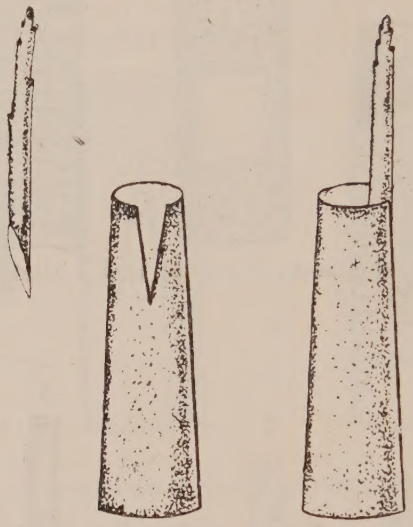
The stock in this case is split open by a sharp knife or chisel and the scion is cut wedge-shaped and fitted into the cleft so that the cambial layers are in contact. The whole is then carefully bound with waxed tape to exclude air and moisture.

2. Side-grafting :—



This consists of inserting scions into the side of a stock without cutting away the top of the stock. The scion is splice-cut and is then inserted under the bark so that cambial layers are in contact. The union is then bound up and covered with clay or wax.

3. Crown Grafting :—



The stock in this case is cut down. The scion is sloped and so shaped that it can be inserted between the bark and the wood of stock. It can only be done satisfactorily at the commencement of the growing season. The bark and wood then easily separate. At the beginning the young scions must be protected by shelters from the sun.

NOTES.

1. It is essential that only a sharp knife should be used in budding or grafting.
2. Good budding tape should be used to wind round buds or grafts.
3. Budding tape may be made as follows :—

GRAFTING WAX.

1 part beeswax
1 part tallow or suet
2 parts resin

Melt the two former in a tin, powder the resin and add to the mixture, stirring and mixing the whole well. When cold it should be of the consistency of fresh putty.

For budding purposes or for small or delicate grafts, the wax may be melted and applied with a small brush whilst in a dilute state. Grafting tape is, however, preferable. This may be prepared by soaking ordinary ½ inch cotton tape in the melted wax, afterwards hanging it up to dry for a day or so.

Success in Java has been obtained by using waxed cotton made by putting ordinary strips of cotton through melted paraffin wax.

4, The reported results from Java are as follows :—

BUDDING.—

50-60% successes were secured at the beginning but after practice the workers were able to secure 90% successes.

GRAFTING.—

Cleft-grafting, 40% successes are reported. It requires great care and is not now generally recommended.

Side-grafting, 55% successes were obtained.

Crown grafting, 75% successes were obtained.

5. Further references to budding or grafting may be made to any standard work on Gardening or to Bulletins 20 and 21 of the Rubber Experiment Station, Java.*

(Signed) F. A. STOCKDALE,
Director of Agriculture.

Department of Agriculture,
Peradeniya, August 26th, 1921.

CONCERNING THE INFLUENCE OF COAL TAR ON THE RENEWING BARK OF HEVEA BRASILIENSIS.

DR. A. STEINMANN.

(*Summary.*)

Besides his application of tar to wounds and to the tapping cut in combating stripe canker, HARMSEN has also recommended its use to obtain a quicker bark renewal on the tapping surface.

The purpose of the investigation reported in this paper was to find whether tar can produce a change in the anatomical structure of the bark, and also to determine whether this tar treatment should be recommended for estate practice.

The tar used in these experiments (furnished by the gas factory of Batavia) penetrated on the tapping cut to a depth of 0·5 mm.; at 1 cm. above the cut, to 0·25 mm.; whereas at a height of 6 cm. above the cut it did not even penetrate through the cork layer. These results agree in general with those of similar experiments carried out by PETCH.

The writer's investigations show that under the influence of coal tar :—

(1) An increase in thickness of the bark can be obtained.

(2) This increase is due only to the accelerated activity of the phellogen or cork cambium. The phellogen produces an unusually large mass of phelloderm-tissues, many cells of which eventually go over into stone cells.

(3) Because no increase in the soft or latex bearing portion occurs, it can not be advised to tar the tapping area regularly each month in order to obtain a quicker development or growth of the bark.—ARCHIEF VOOR DE RUBBERCULTUUR, October, 1921.

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*Note.—Successful patch budding was carried out at the Royal Botanic Gardens, Peradeniya during the month of September. The results of these experiments were communicated to the Estate Products Committee at its meeting held on November 10th, and to a meeting of the Kalutara Planters' Association held on November 30th.—Ed. T. A.

FRUITS.

THE CULTIVATION OF PINE-APPLES.

DEPARTMENT OF AGRICULTURE CEYLON, BULLETIN NO. 50.

Within recent months considerable interest has been taken in the Colony in the possibilities of the cultivation of pine-apples for canning. There seems to be good prospects for such an industry, and therefore it is considered desirable to issue details regarding those cultivation methods which usually give the most satisfactory results.

Pine-apples grow well in all districts of the Colony, and yield satisfactory crops of large fruits. In the higher and colder elevations growth is slow, but below 4,000 feet growth is generally good. Some of the largest pine-apples of the Colony are grown in the Kegalla District, but equally fine fruits can be secured with cultivation in many other localities. Small experimental cultivations have been carried on by the Department of Agriculture at Anuradhapura, Bandaragama, in the Kalutara District, and at Peradeniya. There is one cultivation in the Kegalla District which has been in existence for some time, and it supplies some of the hotels in Colombo with fruit. Otherwise pine-apples are grown in small numbers in village gardens, and the fruits thus secured are disposed of at the nearest vegetable markets. These fruits generally command a ready sale, prices varying with the season and with the location of the market.

VARIETIES.

The principal varieties of pine-apples grown in Ceylon are two in number. They are the Kew and Mauritius kinds. The Kew pine-apple is the well-known Smooth Cayenne variety. It is supposed to have originated in hot-houses in England, and is largely grown in the Azores under glass for supplying the London markets. It has been successfully grown over large areas under shelter in Florida, and is there the most popular and profitable variety. It is the variety grown for the Hawaiian canneries, and is also grown in Porto Rico and other West India Islands. The Smooth Cayenne or Kew pine-apple produces large fruits, which average from 5 to 8 pounds in weight. The plant is a large one, with large leaves smooth on their edges. The fruit is oblong. It tapers very slightly. The colour of the fruit when fully ripe is yellow, but under tropical conditions ripe fruit are still of a light green hue. The crown is well developed and spreading, the leaves of the crown being smooth on their edges, sharp pointed, and tapering gradually to the apex. Its flesh is yellowish, very juicy, and sweet to taste.

In Ceylon it is a hardy plant, and grows well in the damper districts. It requires for its best development better soil and more favourable conditions than the so-called Mauritius varieties of pine-apples which are grown in the Colony.

The so-called Mauritius pine-apples grown in Ceylon are much smaller than the Kew pine-apple, their fruits rarely averaging more than 2½ to 4 pounds each. The plants themselves are comparatively small, and the leaves are coarsely serrated at their edges. There are probably two kinds. The fruits of the red kind are oblong in form, rounded at the base, and slope abruptly to the crown. Their colour is green before ripening, and a reddish yellow when fully ripe. The crown is of medium size, the leaves

being broad at the base and tapering to the apex. The flesh is light yellow in colour, and of medium quality. The yellow variety has slightly differently shaped fruits to the red kind. Its base is rather depressed, and it slopes somewhat abruptly from the middle. It is light green in colour before maturity, and a clear yellow when ripe. The crown is large, and the leaves are coarsely serrate and spiney. The flesh is yellow in colour, and is rather acid to taste.

SOILS.

Pine-apples do not appear to be particular in regard to the classes of soils on which they will thrive. They are found growing satisfactorily on soils of widely different character, and even upon shallow soils of poor quality. They do not thrive well upon heavy clay soils with poor drainage. The pine-apple requires soil that is well drained, and will often do better on poor sandy soils than on richer loams whose drainage is not satisfactory. A light sandy loam is considered to be the best soil for the pine-apple, and if heavier soils are planted up attention must be given to cultivation and to drainage. The pine-apple is most intolerant to excessive moisture, and if drainage is neglected good results cannot be hoped for.

PROPAGATION.

The pine-apple is propagated by *suckers*, *ratoons*, *slips*, and *crowns*. The accompanying illustration will help to make clear these terms. (Plate I).

The "sucker" is an offshoot, growing out from among the leaves of the parent plant. Suckers are the best sources for propagation. If left on the mother plant after the fruit has been harvested they will throw out roots, and these roots may develop around the lower leaves and in the axils of the leaves of the mother plant. In this position the sucker will grow and produce fruit, and the practical importance of this is that where plants are close enough crops of fruits can be reaped from suckers growing on the base of old plants.

For planting, suckers are severed from the mother plant, and after preparation are put out into the soil at the selected distances apart.

"Ratoons" are suckers or offshoots which are thrown out from the main plant underground. They rapidly develop roots of their own, and after the fruit is cut, some of these ratoons are allowed to remain in order to produce the crop of the following year without re-planting. Not more than two good ratoons should be allowed to remain, the others being removed and utilized for planting up new areas.

"Slips" are the plantlets which appear on the fruit stalk below the fruit. They are similar in appearance to suckers or ratoons, but they seldom attain any considerable size. They may be detached and used for planting purposes. The rosette of leaves at the apex of the fruit is known as the "crown," which when cut off from the fruit may be planted.

Frequently a number of slips will be found to have appeared immediately below and around the crown. These are known as "crown slips." They are usually small, and are not used for propagation if other planting material is available.

Most varieties of pine-apples produce a few seeds. The quantity depends upon the locality as well as the season, and some varieties are more productive than others. Experiment stations in Hawaii and America have carried on a large number of experiments with the propagation of seedlings, and a few of the pine-apple varieties thus raised have been of commercial value. The pine-apples grown from seed does not grow true to type. Some of the seedlings are of a quality equal to or superior to that of the parent, but many others are inferior. The propagation of pine-apples from seed is therefore not a commercial possibility, and lengthy experiments are necessary before the true value of a pine-apple raised from seed can be attested.

SELECTION OF PLANTS FOR PROPAGATION.

Care must be given to the selection of material used for planting. Suckers are generally to be favoured for planting, but slips, if large, can also be used. Suckers generally develop on the mother plant before the fruit appears, and such suckers are therefore several months older than the slips. Planted suckers will produce fruit several months earlier than slips.

Ratoons may be planted, but they are not to be preferred to suckers. Their roots die, unless the ratoons are lifted carefully with a good ball of earth. Consequently ratoons take some time to become established.

Crowns may also be used, and give quite satisfactory results if they are large and well matured. If crowns are used, they must be trimmed close to the base, and the cut ends must be allowed to dry in sunlight for several days before planting.

Planting material should be taken from strong vigorous plants which are free from diseases. The suckers should be well matured, and only those in vigorous growth should be selected. A poor sucker will never give good results. An immature sucker will dry up in a short time if the weather is dry, and rot if the weather is damp.

A well-matured sucker never gives rise to these troubles. The suckers should be 12 to 18 inches long, and should be selected from plants which have borne or are bearing fruits. When the suckers are selected, they should be stripped of the lower basal leaves for a height of 1 or 2 inches. This allows roots more readily to appear, and the plants "catch on" more rapidly after planting.

The accompanying illustration shows an inferior sucker, a good sucker, and a good sucker prepared for planting. (Plate II.)

PLANTING SYSTEMS.

Before planting all weeds should be eradicated, especially creeping grasses, such as couch. The land should be tilled, and should be in a fairly loose condition. Opinions differ as to the best distances at which to plant, but in countries growing pine-apples for canneries, the three-row system is now the most popular. The distance between plants depends upon the locality, the soil, and the variety planted. The Kew variety requires more space than the Mauritius kinds, as it grows much more vigorously.

Pine-apple planters adopt methods of planting which range from single rows 3 to 4 feet apart to 10 or 12 rows planted very close together. Some planting is done on the flat, while other growers advocate planting on a ridge. Everything depends upon the soil conditions of the locality. In well-drained soils the flat planting may safely be adopted, while on lands which are of poor drainage the soil should be banked up and planting done on ridges.

The single-row system is the system generally adopted in Ceylon, and the distances between the rows and between the plants in the rows range from 18 inches for Mauritius pine-apples to 2 feet 6 inches or 3 feet for the Kew variety. The single-row system is well-adapted to a friable loam soil and in localities where grasses are troublesome weeds. Its great disadvantage is that as soon as the fruit attains any size it falls over for want of support. When two or more rows are planted close together, support is secured from neighbouring plants, and better fruits are secured. Suckers on plants put out in the single-row system of planting are also frequently broken off.

Some of the objections to the single-row system of planting can be overcome by planting out in double rows, setting the plants 15 to 18 inches apart according to variety, and leaving 3 or 4 feet apart between the double rows. This system can be used in all kinds of soils. It is to be preferred in weedy soils, but in clean soils the three-row system may be adopted. The three-row system consists of planting three rows of plants close together. The generally accepted distances in the three-row system on poor soils are 15 by

Plate I.

1. RATOON. 2. SUCKER. 3. SLIP. 4. CROWN SLIP. 5. CROWN.
(Reproduced from Bull. 8, Porto Rico Agric. Expt. Station.)

Plate II.

1. INFERIOR SUCKER, 2. GOOD SUCKER. 3. GOOD SUCKER PREPARED FOR PLANTING.

(*After Bull. 8, Porto Rico Agric. Expl. Station.*)

15 inches for the smaller kinds of pine-apples, such as the Mauritius types, and 18 by 18 inches for the Kew or Smooth Cayenne variety. In good soils these distances should be increased. A distance of 4 to 5 feet would be left between series of rows, so as to allow inter-culture to be carried out and to afford space for re-planting the field when necessary. The distances that might be recommended for Ceylon, if pine-apples are being grown for a cannery, are shown in the accompanying diagram :—

Single Row.

Mauritius.			Kew.	
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
x	x	...	x	x
15 in. × 30 in.			24 in. × 36 in,	

Double Row.

Mauritius.			Kew.	
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
xx	xx	...	xx	xx
15 in. × 15 in.	15 in. × 15 in.		18 in. × 18 in.	18 in. × 18 in.
30 inches.			36 inches.	

Three Rows.

Mauritius.			Kew.	
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
xxx	xxx	...	xxx	xxx
15 in. × 15 in.	15 in. × 15 in.		18 in. × 18 in.	18 in. × 18 in.
48 inches.			60 inches,	

Number of Plants per Acre.

System of Planting.	Varieties.	Distance apart of Plants in Rows, Inches.	Distance between Rows. 2 ft.	2½ ft.	3 ft.	4 ft.	5 ft.
Single Row...	Mauritius	15	—	13,939	—	—	—
	Kew	24	—	—	7,260	—	—
Double Row	Mauritius	15 × 15	—	18,260	—	—	—
	Kew	18 × 18	—	—	12,558	—	—
Three Row...	Mauritius	15 × 15	—	—	—	15,670	—
	Kew	18 × 18	—	—	—	—	10,545

PREPARATION OF SUCKERS BEFORE PLANTING.

The young plants, whether they are suckers, slips, or crowns, require a certain amount of preparation before they are planted. If the locality is a dry one, or the soil a sandy one liable to drying out, all planting material should be "trimmed." The trimming consists of cutting off the base of the sucker, slip, or crown, and stripping off the lower leaves until the stem is exposed for 1 or 2 inches. The exposed portion of the stem is then allowed to dry for a few hours before planting. Some pine-apple cultivators also cut off the tops of the leaves, particularly if the suckers are large. This practice, however, is not generally recommended. The necessity for trimming suckers, etc,, for planting in a dry locality or during the dry season is obvious. If a sucker is planted without trimming in a dry soil or under dry conditions, the roots which are given out from the stem do not develop properly, and become massed around the stem of the plant. In a dry soil the leaves which cover the stem, unless they are trimmed off from the lower portion, remain hard and dry. They do not readily decay. The young rootlets, therefore, as they grow find considerable difficulty in penetrating these dry and hard bases of the leaves. Consequently the majority of the roots develop between the leaves and the stem, and thereby become massed immediately around the stem. This growth around the stem is also helped by the moisture which is collected from the dew and light showers in the leaf axils, from which it trickles down around the stem of the plant. The soil is thereby drier than the area immediately surrounding the plant, and consequently root growth in the immediate vicinity of the stem is encouraged.

This massing of roots around the stem and their non-development in lateral directions is naturally harmful to the successful development of the plant. Untrimmed plantations in dry localities or during dry seasons do not produce such good crops as plantings which have received proper attention at the beginning.

In loamy or clay soils containing fair amounts of moisture, or in wet localities, the basal leaves of the suckers, slips, or crowns selected for planting rot fairly rapidly, and consequently under these conditions trimming is not necessary to ensure satisfactory root development.

In general, it may therefore be accepted that it is advisable to trim for planting in a dry soil or in a dry season, but for planting in moist soils or in the rainy season such work is not worth the expenditure.

PLANTING OUT.

This should be done with the monsoon rains. The planting seasons would be May-June for the south-west monsoon season, and October to December for the north-east season. The general fruiting season for pine-apples in Ceylon are the months of June, July and August. The pine-apple plant usually takes twelve months or more before it comes into bearing, and therefore plantations made in May-June in the south-west side of the Island should fruit the following year. As this period is the minimum for proper

fruiting, everything should be done to make conditions for growth as favourable as possible. The suckers or slips used for planting should be large ones—12 inches or more in length in the case of the Kew variety. Cultivation should receive careful attention, and manuring should be adopted. Suckers usually fruit somewhat earlier than slips. This is mainly due to suckers being slightly older than slips, but even when suckers and slips are of the same age, there appears to be a slight difference in favour of the sucker as far as fruiting is concerned.

In the drier districts dependent upon the north-east rains, plantings done in October to December will probably give the best results if the majority of the plants fruit in June, eighteen to twenty months later. Plantings done in October may, therefore, be too early unless smaller suckers or slips are used. Those made in December with large suckers will possibly give more uniform fruiting. If very large ratoons or suckers were used for planting with the first rains of the north-east season, it is possible that some of such plants would fruit in the following August. In many north-eastern districts good showers are experienced in April, and this season could be utilized for plantings which are required to fruit some fifteen to eighteen months later.

In Ceylon at the present time no regular season is adopted for planting pine-apples, and consequently fruit can be secured in every month of the year. As previously stated, however, the main fruiting season is during the months of June to August, and if a canning industry were established, the bulk of the crops would be harvested during these months. A certain amount of experiment would be necessary in the initial stages, and as experience was gained, control of fruiting by times of planting, systems of cultivation, etc., would be evolved.

It may be accepted, however, that large ratoons or suckers with good cultivation and proper manuring will produce fruit in about 12 months, while ordinary plantings in the drier districts will take from fourteen to 18 months to fruit.

In sandy soils it is important that small suckers or slips should not be used. They become filled with sand, especially after wind or heavy rain, and this is detrimental to growth.

CULTIVATION.

The pine-apple has a shallow root system, which does not extend at any great distance from the plant. Planting can, therefore, be done fairly close, and cultivation limited largely to weeding and hand cultivation immediately around the plants. Rows of plants may be 15 to 18 inches apart, and the distances between the plants in the rows need not exceed these distances. Adequate space must be left for paths, in order that plants are not injured during weeding or cultivation. The pine-apple will not succeed if its leaves are being constantly injured or broken, and one often sees plants which have been put out in gardens along the edges of paths struggling with many broken leaves for an existence. If the three-row system of planting is adopted, the paths left between the series of three rows should be regularly cultivated and kept free from weeds. It is in these paths that the planting of the next crop will be made. The land should, therefore, be kept in good tilth, and should not be allowed to become hard or weedy. All weeds in the rows of plants should be regularly pulled out, and light forking and hoeing carried out in the earlier stages. Weeds are detrimental to the growth of the pine-apple. If they are allowed to grow, stunted plants and inferior crops will result.

MANURING.

No experiments on manuring pine-apples have been conducted in Ceylon, and therefore it is not possible to state with certainty what manures are required for Ceylon soils and conditions. In the wetter districts

pine-apples apparently grow luxuriantly and yield satisfactory crops without manure, but there is little doubt that beneficial results would follow the application of manures. If pine-apples are to be cultivated continuously, some system of manuring would be necessary to assure continued satisfactory results.

In Florida, where pine-apples are grown on very poor sandy soils, very careful attention is given to manuring, and, similarly, in Hawaii, crops have only been maintained by the use of artificial manures.

The root system of the pineapple is shallow and limited in its lateral extension. Manures must, to be beneficial, be applied on or immediately around the plant. If the rows are far apart, and the manure is applied in the spaces between the plants, it is not reached by the roots, and consequently is largely lost. In field practice it is usual in the single-row system of planting to apply manures to each individual row of plants, while in the three-row system the manure is scattered broadcast over the plants. The manure lodges in the axils of the leaves, and is gradually washed down from the leaf bases to the soil immediately surrounding the stem.

It is, therefore, essential to avoid injury to the foliage. The manures used should be neither acid nor caustic. Sulphate of ammonia or nitrate of soda should be avoided, and organic sources of nitrogen, such as castor cake, groundnut cake, or dried blood employed. Sulphate of potash is to be preferred to other potash salts, and acid phosphates are to be avoided. Steamed bone meal is likely to prove a satisfactory source of phosphorus. The manures should be given in two or three applications. The first can be made immediately after the plants have become established, the second two to three months later, and the last application just as fruit is beginning to appear.

In Porto Rico it is recommended that nitrogen alone should be applied at the first manuring, and that at the last application the percentage of potash should be increased. Manurial mixtures in the ratio of 10 lb. nitrogen, 20 lb. potash, and 8 lb. phosphoric acid per 1,000 plants are recommended. Such large applications would not be necessary in Ceylon, and it is possible that a ratio of 5 lb. nitrogen, 10 lb. potash, and 5 lb. phosphoric acid per 1,000 plants would be likely to meet Ceylon requirements. Accurate information, however, can only be secured as the result of experiment, and until experiments have been carried out only generalizations can be made.

FRUITING.

The time of fruiting depends, as has been explained previously, on various factors. All fruit before it is picked should have become full in size, and, if canning is to be done, should be mature. There are several methods of judging the degree of ripeness of a pine-apple fruit. This is not difficult in the field, but it requires experience and a certain amount of skill. The opening and spreading of the crown may be taken as one of the best tests of maturity.

The nearer a pine-apple is to full maturity and ripeness when harvested, the better the quality.

The fruits of some varieties of pine-apples will break off readily without injury to the fruit if they are given a quick sharp jerk. With other varieties, such as the Kew variety, a knife must be used, and the fruit cut off from the stems. After cutting, the fruits should be sorted into different grades in the field, and then collected in baskets, trucks, or other means of conveyance for transport to the sorting house or canning factory. If the fruit is to be packed in cases for shipping to temperate markets, a second grading is done in the "sorting house"; if they are required for a cannery, the field grading is sufficient.

Plate III.

KEW PINE-APPLES GROWING AT ANURADHAPURA EXPERIMENT STATION.

Plate IV.

PINE-APPLES PLANTED IN SINGLE ROWS AT ANURADHAPURA EXPERIMENT STATION.

YIELDS.

Accurate acreage yields have not been secured in Ceylon, as only very small areas have been devoted to pine-apples on the experiment stations, and private cultivations consist mainly of small plantings in gardens. In good cultivations 75 to 90 per cent. of the plants should produce fruits, of which at least 75 per cent. should be of sufficiently large size. If, therefore, 10,000 plants are set out per acre, some 5,000 to 6,000 large-sized fruits should be secured.

Yields of 8 to 10 tons of fruit per acre are reaped in Hawaii and other pine-apple-growing countries, and in favourable districts in Ceylon similar crops should be secured. In the drier districts the yields would be smaller.

TREATMENT OF FIELDS AFTER HARVESTING.

After the bulk of the crop has been harvested, the field should be thoroughly cleaned, weeded, and hoed. All dead or badly injured leaves should be cut off, all dead or diseased plants removed, and all weeds removed.

Slips and suckers should be removed—after maturity, if they are required for planting purposes—and all ratoons, except two, should be dug up. If the soil is rich, three ratoons or basal suckers can be left for the second or ratoon crops but if good-sized fruits are desired, the number of ratoon shoots or suckers should be strictly limited. In the case of the three-row system the retention of ratoons only need not be insisted upon, as the suckers often give satisfactory crops of good fruit. It is often found that suckers develop towards the tops of the plants and cannot, therefore, be retained for the ratoon crop. If these high suckers are pulled off, others will be formed lower down on the plants. The development of ratoons may even be induced by the removal of suckers as formed. After the suckers and weeds have been removed, the soil between the plants should be broken up if possible and earth from the paths between the series of rows thrown around the plants to replace that which may have been washed away. Manuring should then be carried out, an application slightly heavier than that given to the first plant crop being made. Plants still bearing unpicked fruits should be left until after the fruits have been harvested, when they should receive individual attention.

The time a field can be kept under pine-apples without replanting depends upon its fertility, the cultivation given to it, and the amount of manure added.

Re-planting in many countries only takes place every five, ten, or even fifteen years, but in others a maximum of three crops is considered to be sufficient. In the last year a low-growing green manure should be planted in the paths between the series of rows. This should be ploughed under and re-planting then carried out. The old rows should be thoroughly ploughed out and green manure crops sown. In this manner the general fertility of the soil will be maintained and good crops assured.

CANNING.

The canning of pine-apples is operated on a large scale in the Straits Settlements, Hawaii, Florida, the Bahamas, and to a smaller extent in Jamaica. A factory can only be successfully operated if a regular supply of suitable fruit is available from properly cultivated areas. It is usual for the factory to have a nucleus in an area of pine-apples cultivated under its own management, and to rely to a lesser extent upon purchases from other growers. In countries depending upon export for their trade, the majority of pine-apple canneries are situate at the port of shipment, and it is probable that if a factory were erected in Ceylon, it would be advisable that it should be erected in Colombo. A pure water supply would there be available, a

labour supply could readily be secured for the busy season, and transport for shipment would be facilitated. The supplies of fresh fruit from the cultivations could be transported to the factory by railway, and it would be desirable that the factory should be placed on the railway line if possible.

In the Straits Settlements the pine-apples are peeled by hand. The tops and bottoms of the fruits are first cut off. The fruit is then held in the left hand, which is covered with a rubber glove, and peeled with a sharp knife. The cores are removed by a tin tube, which is pressed through the centre, and the fruit is then placed in tins, which are filled up with water or syrup, In many cases in Singapore the cores of the fruit are not removed. The syrup for the cans is made of 1 lb. of sugar to about 4 gallons of water, and after the fruit is placed in the tin it is soldered up. The tins are then plunged into a tank of water heated by steam and are boiled for about 10 minutes in the case of the smallest tins and up to over an hour for the large tins. After removal from this tank a small puncture is made in the top of the tin in order to let out the steam, and subsequently the holes are re-soldered, and the tins again plunged into boiling water for nine minutes.

The exports from Singapore include whole pine-apples, pine-apples which have been cored, and pine-apples in slices.

In the Bahamas the pine-apples are peeled by hand, the core removed by machines, the fruits then sliced by machinery. These slices are then packed in tins with syrup and cooked.

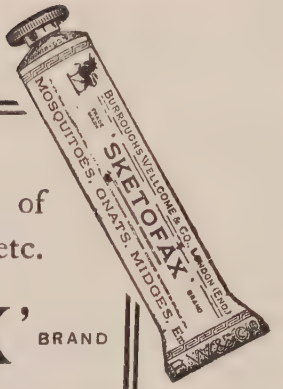
In Hawaii machinery is used throughout. The fresh fruit are first put through a sizing machine, which removes the whole of the rind and makes a cylinder of fruit the same size as the tin to be used. The core of the fruit is next taken out by a special machine, and the fruit then passes along to be sliced. The fruit is now ready for the tin, and after it has been put into these, the tins are taken to the syruper, where syrup made of sugar and water, or pine-apple juice, is added. The top of the tin is next put on, and the tins are then exhausted in steam for about 4 minutes. Subsequently the tins are passed along on an endless chain for the actual cooking. This is done by passing them through a cooker, which is kept at 212°F. The tins of fruit take 10 minutes to pass through the cooker. On coming from the cooker the tins are cooled for 4 minutes, and when cold are tested for leaks. If any leaks are discovered, these are repaired, and these tins again sent through the exhaust.

After the cans are thoroughly cooled, they are labelled and packed for export.

COST OF FACTORY.

It is somewhat difficult at the present time to give with accuracy the probable cost of an up-to-date modern canning factory, but information received in Colombo by MR. W. BEER, who was formerly connected with pine-apple canning factories in Hawaii, indicates that the cost of cannery, including a tin-making machine, would, at the present time of unfavourable American exchange rates, be about Rs. 80,000. Such a factory would be capable of turning out 100 cases of tinned fruit per hour—equivalent to about 4 tons of fresh fruit. It would therefore be capable of handling the produce of about 350 acres in a season.

F. A. STOCKDALE.



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FOODSTUFFS.

MOKI LIMA BEANS.

The following is an abstract of Bulletin No. 9 of the Sultanic Agricultural Society written by DR. H. F. FORBES, Agronomist :—

Moki lima bean has been grown with success by the Moki Indians of Northern Arizona from time immemorial, and was introduced into Egypt by the writer in 1918 as an additional food crop in the already tight fitting scheme of the Egyptian rotation.

This bean is a semi-dwarf of *Phaseolus lunatus* with slender vines running to a length of 1 to 1½ meters in good soil. The vines are smooth and non-twining, refusing to climb even when provided with supports. Seeds are small and are pure white, pale buff and copper red. Pale buff may be variegated with black in all proportions, and also with red. Red may be flecked with black. Pale buff and red specimens darken with age—buff to brown, and copper red to deep red. Whites maintain their colour.

The non-twining and semi-dwarf habit of the Moki lima places it among field rather than garden crop; while the leguminous character of the plant and the nutritive value of the crop indicates a high food return with minimum drafts upon the soil. Of all the colour variants, the White Moki is the promising commercially.

DEVELOPMENT OF THE PLANT.

Moki lima bean requires about four months of warm weather to mature a crop of dry beans, and it is therefore especially suited for tropical and

sub-tropical climates. It is considered hardy to a somewhat wide daily and sessional range of temperatures, and is drought resistant. It is susceptible to frost.

It flowers profusely beginning from 7 to 9 weeks from planting according to season, but only a small percentage of the flowers develop pods.

CULTURE.

In Arizona, Moki lima beans are grown in sandy soils, but good results have been obtained in Egypt in medium and light Nile soils. It will not endure an excess of soluble salts in the soil.

The land is prepared in the usual way with flat-topped ridges, separated by furrows 90 cm. apart. Four seeds are planted in one hill and subsequently thinned out to two with hills 70 cm. apart

The green bean of Moki lima is an excellent vegetable, cooking quickly by reason of its small size. The proportion by weight of shelled beans to whole pods averages about 45 per cent.

ROTATION.

In Egypt Moki lima bean is used in the rotation of vegetables, wheat and barley, cotton, berseem, etc,, and in all these the leguminous nature of the crop helped to renovate the soil.

TUBERCLES.

This bean has failed to develop tubercles in Egypt, but after several attempts with cultures from various sources this has been overcome.

DISEASES AND PESTS.

Moki bean has been so far free from diseases, and has been but little attacked by insects. An unidentified leaf spot fungus was observed near Cairo in November and December. Occasionally, late in the year, pods may be seen slightly marked by a small spot fungus, which apparently does no harm to the crop. The only insect attack upon the vines or foliage was by grasshoppers, but a worm *Etiella zinkinella* damages green seeds in the field and a bean beetle *Bruchus irresectus* attacks dry beans in the field and also in storage, where it can be protected by fumigation, by naphthalene, and by storing in heavy muslin sacks.

YIELDS.

The following are the results of some experiments carried out near Cairo and at Kom Ombo in soils ranging from light to medium clays, and under both humid and comparatively arid climatic conditions :—

1. Giza farm, Giza.

Planted July 14, 1919 : harvested November 8-9.

Silty Ghezireh soil ; fertilized with 40 cu.m. per feddan=(1 acre 184 sq. yds) farmyard manure.

Area.—1·42 feddans=(1 acre, 2,289 sq. yds.) yield, 875 kilos (17 cwt. 25 lb.) first class beans ; per acre 11 cwt. 78 lb.

2. Bahtim farm, near Cairo.

Planted March 7, 1920 ; harvested June 30.

Soil medium clay ; following maize, no fertilization ; roots without tubercles,

Area.—·233 feddans (1,166 sq. yds.) ; yield 212·5 kilos (4 cwt. 20 lb.) ; (per acre, 17 cwt. 22 lb.)

3. Bahtim farm, near Cairo.

Planted April 18, 1920 ; harvested August 21.

Soil medium clay ; following maize, no fertilization, no tubercles, plot injured on one side by mulberry trees.

Area.—·222 feddans ; (1,113 sq. yds.) ; yield, 93 kilos (1 cwt. 93 lb.) ; (per acre, 7 cwt. 107 lb.)

4. Bahtim farm, near Cairo.

Planted June 22, 1920 ; harvested October 23.

Soil medium clay ; following maize and fallow ; no tubercles ; fertilized with 190 kilos (3 cwt. 82 lb.) sodium nitrate per feddan (1 acre 184 sq. yds.),

Area—·76 feddans (3,775 sq. yds.); yield, 459 kilos (9 cwt. 4 lb.); (per acre, 11 cwt. 65 lb.) Damaged waste, 5 kilos (11 lb.) or 1·1%

5. Bahtim farm, near Cairo.

Planted July 11, 1920; harvested November 16.

Soil medium clay; following early crop of lima beans; no tubercles; no fertilization.

Area.—·233 feddans (1,166 sq. yds.); yield, 188 kilos; (3 cwt. 78 lb.); (per acre, 15 cwt. 38 lb.) Damaged waste, 6 kilos, (13 lb.) or 3·2%

6. Giza farm, Giza.

1st Planting, March 12, 1920; harvested July 19 to September 3.

Silty Ghezireh soil, following colocassia, in poor condition no tubercles; fertilized with 700 baskets of Kufri per feddan.

Area.—1·1 feddans (1 acre 686 sq. yds.); yield, 370·5 kilos (7 cwt. 32 lb.); per acre, 6 cwt. 43 lb.

2nd Planting.—April 6, 1920; harvested August 2 to September 8.

Soil same as for 1st planting.

Area.—1·04 feddans (1 acre 385 sq. yds.); yield, 381 kilos; (7 cwt. 32 lb.); per acre, 6 cwt. 106 lb.

The prolonged harvest in these two plantings is due to a shortage of water (June 27 to July 19) followed by renewed irrigation. This caused new bloom and a second crop of pods from the same vines. These low yields are due to exhausted soil, poor stand and shortage of water, but roughly indicate the possibilities of this bean under dry farming conditions.

7. Giza farm, Giza.

Planted for green beans March 1, 1920; harvested June 11 to July 12.

Silty Ghezireh soil, following beans; no fertilization.

Area.—·67 feddans (3,366 sq. yds.); yield, 695 kilos of pods (13 cwt. 76 lb.) per acre 19 cwt. 74 lb. of pods, fresh shelled 8 cwt. 96 lb.

8. Teftish of the Societe Anonyme de Wadi Kom Ombo.

Planted August 13, 1920; harvested December 10; soil heavy: plot shaded on one side by hedge of *P. aculeata*; no tubercles, no fertilization.

Area.—18 feddans (904 sq. yds.); yield, 75 kilos (1 cwt. 53 lb.); per acre 7 cwt. 101 lb.

9. Giza farm, Giza.

Planted September 16, 1920; harvested January 12, 1921, not fully mature. Silty Ghezireh soil following cowpeas; no fertilization and no tubercles observed.

Area.—1·7 feddans (1 acre 3,700 sq. yds.); yield, 485 kilos (9 cwt. 61 lb.); per acre 5 cwt. 45 lb.

A poor crop of inferior quality, due to very late planting.

From these results it will be observed that early plantings are favourable.

COMPOSITION AND FOOD VALUE.

The following analyses, by J. A. PRESCOTT, Chemist of the Societe Sultanienna d'Agriculture, are of samples of Moki lima beans collected from various sources and include both original Arizona seed and successive crops grown in Egypt from this seed. These analyses include nitrogen and starch and afford a means of determining the comparative food value of this crop.

No.	Where Grown.	Date of Crop	Moisture in Meal	In water-Free Material	
				Nitrogen	Starch
		%	%	%	%
44	Prescott Dry Farm Northern Arizona ...	1917	10·59	3·73	33·4
44b	Giza Farm, Egypt	1919	11·72	2·94	43·3
44d	,, ,, ...	1920	10·45	3·19	35·6
44d or e	Bahtim Farm, Egypt ...	1920	12·2	2·85	38·8
44d	Behigue dry farm, Egypt ...	1920	10·43	3·40	32·1
45	Indian farms, Northern Arizona	1917	10·63	3·36	35·6
46	,, ,,	1917	10·68	2·99	38·4
46a	Doki field near Cairo, Egypt ...	1918	11·3	2·63	45·1
46b	Giza Farm, Egypt	1919	11·83	2·46	38·8
46c	,, ,, ...	1920	1·71	2·42	31·9
47b	,, ,, ...	1919	11·33	2·54	37·6
48a	Doki field near Cairo, Egypt ...	1918	11·54	2·81	40·8
49a	,, ,, ,, ...	1918	11·62	3·31	38·7
50	Indian farms, Northern Arizona	1917	10·34	3·41	35·9
50b	Giza Field, Egypt	1919	11·19	2·71	35·2
	Average of all Moki limas from Arizona, presumably tuberculous	1917		3·37	35·8
	Average of all Moki limas grown in Egypt, not tuberculous ...	1918-1920		2·84	38·0

The following comparative figures of Moki beans with maize, the principal food crop of Egypt, will be of interest :—

	In Water-free Material.		
	Nitrogen.	Ether Extract.	Starch.
	%	%	%
Moki limas, 11 samples grown in Egypt, not tuberculous ...	2·84	1·28*	38·0
Maize, 6 varieties, grown in Egypt	1·71	2·16	65·4

For these known constituents it may be assumed that starches are entirely digestible; either extract 90% digestible; and crude protein (=nitrogen by 6¼) three-fourths digestible. Then *digestible constituents* of maize and Moki limas are as follows :—

	In Water-free Material		
	Crude Protein.	Ether Extract.	Starch.
	%	%	%
Moki limas, 11 samples ...	13·32	1·15	38·0
Maize, 6 varieties	8·01	1·94	65·4

From these digestible constituents, nutritive ratios may be calculated as follows, protein being compared with starch plus fat (ether extract) multiplied by 2¼ :

For Moki limas, digestible

Protein ...	...	=	13·32
Fat (1·15 by 2¼)	...	2·59	
Starch ...	...	= 38·00	40·59
and 13·32 : 40·59=a nutritive ratio of	...	1 : 3·05	

* 8 samples.

For Maize, digestible

Protein ...	...	=	8·01
Fat (1·94 by 2¼)	...	= 4·37	
Starch ..	...	= 65·40	69·77

and 8·01 : 69·77=a nutritive ratio of ... 1 : 8·70

Of these two ratios the one for limas, 1 : 3·05 contains an excess of protein and is therefore "narrow"; while the maize ratio, 1 : 8·70, contains an excess of starch and is "wide."

As a foodstuff Moki lima beans are rich in nitrogen.

KURAKKAN AS A GARDEN CROP.

W. MOLEGODE,
Agricultural Instructor.

In Ceylon the cultivation of Kurakkan (*Eleusine coracana*) is so closely associated with chena cultivation that it is not even talked of as a garden crop though in areas like Yatinuwara and Harrispattu, to mention only a few places, it is really treated as a garden crop. *Chenaing* as everybody knows is the felling of thick jungle and even forests for the cultivation of principally Kurakkan and Millets such as *Amu* (Panicum), *Tana* (Setaria italica) interplanted and sown with a few varieties of country vegetables chiefly gourds and chillies and maize in certain districts. Each such cleared area is never cultivated more than once in 8-10 years in chena districts proper where jungle lands abound and 6 or 7 years in the more opened up districts like Tumpane and Hewaheta.

In districts such as Harispattu, Yatinuwara and Udunuwara, though little Kurakkan and Amu are cultivated regularly—and the system of cropping is different to those obtained in chena districts—almost every *Hena* is cultivated at frequent intervals and generally not allowed to lie fallow for longer than 3 years. I know of areas on which Kurakkan is the chief crop every third year. At the South-west monsoon Kurakkan is sown soon followed by Amu. The next season the land is planted with vegetables and kept on till the following North-east monsoon, and at the third year's S.-W. monsoon it is again sown with Kurakkan This is really a rotation of crops but of course a careful selection of crops are not made. Attempts at improving this method of cropping are succeeding in certain areas where uncultivated lands are few, e.g. directly after the Kurakkan crop has been gathered the soil is prepared for Beans which crop is cultivated twice over; after a short interval sweet potato or cassava is grown and this crop is generally, though not immediately, followed by Kurakkan again.

Much better results can be obtained if Kurakkan is treafed as a garden crop and wherever cultivated on small areas this method is the best to adopt.

Kurakkan will grow on most soils provided good surface drainage is provided. The land should be clean weeded and if worked to a depth of 4 to 6 inches it is all the better but even if the surface soil is well stirred it would do. A good tilth is necessary. The land should not be swampy. With early rains seed should be sown broadcast: 5-6 lb. of seed will be sufficient to sow an acre. Hardly any after attention is necessary until the crop is harvested. The crop matures in 3 to five months according to the variety grown. The sowing should be so regulated as to have no rains during harvest. The heads ripen unevenly and should be gathered as they mature. Sometimes harvesting operations extend to two or three weeks. The heads are dried in the sun and the grain is threshed out by pounding the ear heads. A crop of 2,000 to 3,000 lb. may be obtained by cultivating Kurakkan as a garden crop.

SOILS AND MANURES.

SCIENCE AND CROP PRODUCTION.*

E. J. RUSSELL, D.Sc., F.R.S.,

Director of the Rothamsted Experiment Station.

The beginning of much of our scientific work on crop production goes back to the year 1843, when LAWES and GILBERT set out to discover why farmyard manure is such an excellent fertiliser. Two opposing explanations were offered by the chemists of the day; the older view, coming down from the eighteenth century, was that the fertilising value lay in the organic matter; the newer view put forward by LIEBIG in 1840 was that it lay in the ash constituents—the potash, phosphates, etc.—left after the manure is burnt. LAWES and GILBERT considered that it lay in the ash constituents *plus* the nitrogen of the organic matter, and they devised a critical field experiment to decide the matter. They divided a field of wheat into plots of equal size, of which one received farmyard manure at the rate of 14 tons per acre, another received the ashes of exactly the same dressing of farmyard manure, a third received the mineral matter of the ashes *plus* some of the combined nitrogen that had been dissipated on burning, and a fourth lay unmanured. The results were very striking:—

BROADBALK WHEAT FIELD, 1843.

	Grains Tons per acre.	Straw Cwt. per acre.
Farmyard manure ...	22	13
No manure	16	10
Ashes of farmyard manure ...	16	10
Mineral matter of ash *plus* sulphate of ammonia to supply combined nitrogen	26¼	15¾

The ashes proved ineffective, but the ashes *plus* the combined nitrogen acted just as well as farmyard manure; it is therefore these that constitute the fertilising constituents of the manure. Thus the old controversy was decided in a way not uncommon in science; neither side proved to be entirely correct, but both sides were found to have some basis of truth. LAWES and GILBERT did not rest content with this purely judicial and scientific conclusion; they saw that they could make up this effective mixture of ashes and combined nitrogen from mineral substances without using farmyard manure. Even in their day farmers were unable to obtain sufficient farmyard manure, and it was therefore a great achievement to be able to supplement the limited supplies by this mixture. A factory was set up, and the manufacture of the so-called artificial fertilisers began. Subsequent experience showed that the ash constituents are not all equally necessary; in practice only two of them, potash and phosphates, need be supplied in addition to nitrogen.

* Abstract of a farmers' lecture of the British Association delivered at Edinburgh on September 7.

Chemists are rightly proud of artificial fertilisers, for they have proved extraordinarily successful in augmenting crop production all over the world. The demand for them is enormous, and in consequence prices have risen considerably within the last thirty years. Agricultural chemists are always looking out for new substances, and even during the war a new fertiliser, ammonium chloride, was added to the list and new plant has been erected for its manufacture. Modern manufacturing facilities are, perhaps, adequate for present demands, but it is certain that much more fertiliser could be used, and that as farming improves the demand will increase.

Progressive farmers have long passed the stage when it was necessary to demonstrate that artificial manures increase crop production ; the position now is a much more difficult one of deciding how much money it is wise to spend on fertilisers. The old view was that the crop yield was proportional to the manurial dressing—i.e. that the more the manure the bigger the crop. LAWES and GILBERT showed this was not altogether correct, and that the yield fell off after a certain sized dressing was reached. A later view set up by MITSCHERLICH was that the effect of the manure is proportional to the decrement from the maximum obtainable ; that therefore the first dose of manure has a large effect ; but that further doses have progressively less action. The present view is that the effect is at first small ; then it increases and then decreases. The important practical consequence is that moderate dressings are more profitable than small ones, but they are also more profitable than much larger ones. There is no difficulty about the general rule; the difficulty arises when one tries to define a moderate dressing. The problem is further complicated by the fact that the effect of the dressing is greatly influenced by the time when it is put on to the land. In our own case the results have been as follows :—

	Increased yield of grain Bushels per acre			Increased yield of straw Cwt. per acre		
Date of application of manure	Feb. 10	Mar. 6	May 10	Feb. 10	Mar. 6	May 10
Single Dressing	Nil	0·9	2·7	2·7	6·9	9·4
Double Dressing	7·0	—	3·7	11·7	—	12·7

This experiment ought to be repeated in many districts, for it is by no means certain that farmers generally are using the most profitable quantities of fertiliser at the most effective time. It is, however, necessary to take into account something more than the quantity and the time of application of the fertiliser. It is essential also to have a suitable mixture. In the old days this question was thought to be fairly simple. Chemists used to think that if they knew the composition of the ash of plants they would know what manure to use ; it should supply all the ash constituents in the quantities present in the plant. This is now known to be wrong ; the composition of the ash affords no guidance to manurial requirements, as was, indeed, shown by LAWES and GILBERT in 1847. The distinguished French chemist, GEORGE VILLE, emphasised the fact that only properly conducted field trials would ever settle the question. Vast numbers of such experiments have been made, and they show that the problem is more complex than VILLE thought. It is now known that no single formula expresses the fertilizer needs of a crop ; every district, almost every farm, has its own special requirements.

Still further difficulty is introduced by the fact that the various artificial fertilisers not only increase crop yields, but also influence the composition and habit of growth of the crop. Nitrogenous manures tend to a vegetative growth of large, deep-green leaves which are somewhat liable to be attacked by fungoid pests. Phosphates improve root development, and are therefore of special value for swedes and turnips; they also hasten ripening of grain, and are therefore particularly useful in late districts; they increase the feeding value of crops, and are therefore useful for fodder crops; and they have a remarkable effect on the development of clover, which is not yet fully understood, but which has revolutionised the treatment of pastures in this country. Potassic fertilisers improve the vigour of the plant and increase its power to resist fungus attacks. These and other special properties of fertilisers are now well established, and advantage is taken of them in drawing up fertiliser schemes to suit the special requirements of each farm.

It has already been pointed out that this work on artificial fertilisers arose out of LAWES and GILBERT'S discovery that the wheat crop of 1843 grew just as well when supplied with the ash constituents *plus* combined nitrogen as when supplied with farmyard manure. They repeated the experiment year after year: periodically the results were collected, and even after fifty years on an average the artificials had done as well as the farmyard manure. In consequence of this and other experiments many agricultural chemists developed the view that artificial manures were at least as good as farmyard manure for ordinary use on the farm; but wider knowledge has shown that this is not the case; it is only a first approximation to say that artificial fertilisers are equally as good as farmyard manure; we now know that farmyard manure produces effects of the highest importance to the land which no known combination of artificial fertilisers will bring about.

Examination of the Broadbalk data in the statistical laboratory recently instituted at Rothamsted under MR. R. A. FISHER shows that farmyard manure differs in two ways from artificials—the variation in yield from year to year is diminished by the use of farmyard manure, as is also the deterioration in fertility due to continuous cropping for eighty years. No fewer than fifteen different combinations of fertilisers are tested against farmyard manure, and while some of them come out quite well on an average of twenty-five or fifty years, they fluctuate considerably from season to season, and they show manifest signs of deterioration as the years pass by. Many farmers prefer a steady yield to a fluctuating one, and this, of course, is sound, cautious business. Farmyard manure never does badly even in the worst seasons, but, on the other hand, it does not give record crops even in the best seasons. What we should like would be something possessing the special values of farmyard manure in bad seasons, and of artificials in good ones.

Further, there is a deterioration of yield on all our plots treated with artificials excepting perhaps those receiving exceptionally high dressings, This is shown on both the wheat and the barley plots, and it is greatest on those plots where one of the essential fertiliser constituents is withheld.

There is a third effect, which is very marked in rotation. Farmyard manure appears to have a greater effect than artificials in increasing the

growth of clover. Unfortunately the number of experiments is not very great, but, so far as they go, they show a striking superiority over artificials, and this extends not only to the clover, but also to the succeeding wheat crop.

The results at Rothamsted are :—

Manure applied to previous corn crop.	Yield of clover hay Cwt. per acre	Yield of succeeding wheat crop	
		Grain Bushels per acre	Straw Cwt. per acre
Farmyard Manure ...	62	45	45·3
Artificials only ...	46	37	36·8

At present we cannot explain all these remarkable facts. There are several possibilities :—

(1) Farmyard manure is known to exercise remarkable physical effects on the soil, causing it to become puffed up so that the empty pore spaces increase in size. The air supply to the roots thus becomes better, the water supply is more evenly regulated, the work of the tillage implements is lightened, and a good tilth is more easily obtained.

The difference is well shown by the root crops—swedes, turnips, and particularly mangolds, which are very sensitive to soil conditions, and being sown late, are liable to suffer from spring and summer droughts. The plots at Rothamsted receiving farmyard manure contain always some 2-5 per cent. more moisture than those receiving no manure or artificials only, and this enables the mangolds to keep growing during a drought which effectually checks all plants not receiving farmyard manure.

(2) It is possible that there are chemical constituents in farmyard manure which are not present in our artificial fertilisers. The old idea that nitrates, potash, and phosphates only are necessary may be wrong. Recent work by MAZE in Paris and by DR. WINIFRID BRENCHLEY at Rothamsted show that some of the other elements may also be helpful. In the Rothamsted experiments very small quantities of boric acid added to the soil caused distinct increases in crops fully fertilised with artificial manures. We cannot as yet recommend farmers to adopt this kind of manuring with special substances, because it is very easy to overstep limits and do much damage to the crop, for the plant suffers seriously from even slight excess. With fuller knowledge, however, it may prove possible to keep this special manuring within bounds.

(3) In the case of the clover crop the farmyard manure or the straw in the litter may have a special effect on the organisms living in the root, causing them to increase the amount of nitrogen fixation and thus give larger clover crops and further enrich the soil in nitrogenous organic matter.

Work on these problems is progressing ; the scientific investigator has, of course, to find out exactly what is happening before he can show the practical man how to exercise control.

But in the meantime it is necessary for us to be practical and to do something, and the most obvious line of action is to increase the amount of farmyard manure or similar substances on the farm. We can proceed in two ways ; first, wastage can be cut down. We estimate that the farmers of the United Kingdom make about fifty million tons of farmyard manure a

year, and waste about ten million tons. We have shown that the best results are obtained when manure is made under cover and the amount of litter properly adjusted to the amount of nitrogen in the animal excretions. Correct adjustment is a counsel of perfection, but a great improvement is possible over the present haphazard methods. In practice nitrogen is always lost through exposure to weather, greatly to the detriment of the manure. The provision of some shelter for the heap is not difficult, and, as PROF. BERRY has shown at Glasgow, it is distinctly advantageous.

Another method is to increase greatly the amount of farmyard manure or similar substances produced on the farm. This could be done by running on more animals. The number of livestock per acre could be much increased by the general adoption of the methods of some of the Scottish and Danish farmers, who keep their animals largely on the produce of their arable land. The problem is closely bound up with financial consideration, but the experiments of Mr. J. C. BROWN at the Harper Adams Agricultural College show that more profit is obtainable from the soiling system than from the older methods of the south.

At Rothamsted we are examining possible substitutes for farmyard manure, green manuring and the activated sludge method of producing manure from sewage, both of which seem quite promising. We tried using straw as manure, but without success; so soon, however, as the straw was rotted, much more promising results were obtained. The conditions for the proper rotting of straw, investigated at Rothamsted by Dr. H. B. HUTCHINSON and MR. E. H. RICHARDS, were found to be proper air and moisture supply, suitable temperature, freedom from acidity, and the proper proportion of soluble nitrogen compounds. All these conditions are easily obtainable on the farm, and it is now possible to make an artificial farmyard manure from straw without the intervention of animals. So far the results seem quite satisfactory. Arrangements are being made for demonstrations on an extensive scale during the present season.

All these problems I have been discussing represent work of interest to the present generation of farmers; but the scientific investigator cannot be restricted to problems of present-day interest. Some of the best work of to-day may never reach the farmer in our time, and, indeed, unless it is developed, it will never reach the farm at all. We now know that the farmyard manure and the green manure put into the soil are not really agents of fertility, but only raw materials out of which fertility is manufactured The work is done by myriads of living creatures in the soil, which are too small to be seen by the naked eye, and only incompletely revealed even by powerful microscopes. Some of them are useful to the farmer and some not, many of them taking their toll of the valuable plant food in the soil. Their activity fluctuates daily, almost hourly, and their numbers are counted and their work is watched in our laboratories. Much of their activity is helpful to the farmer; it makes nitrates indispensable for the growth of plants. Much of their time, however, is spent in undoing the good work they have done, and results in the destruction of a large proportion of the nitrates made. We are studying this population, and with fuller knowledge we hope to control it and make it serve the farmer just as horses, sheep, and cattle do; but we are a long way from that yet

Finally an attack is being made on a much more difficult problem. The growth of a crop is like the movement of a motor-car ; it cannot go on without a continuous supply of energy. In the case of the car the energy comes from the petrol ; in the case of the growing crop it comes from sunlight. The plant as we grow it, however, is not a very efficient transformer ; a crop of wheat utilises only about half of 1 per cent. of the energy that reaches it. During the last eighty years the growth of crops has been improved, thus increasing their efficiency as utilisers of energy : but we are still a very long way from the 30 per cent. efficiency which the motor engineer has attained. Better developments of our present methods will no doubt carry us further than we have yet gone, but some wholly fresh ideas are necessary before we can hope to bridge the enormous gap that now exists between the actual and what is theoretically possible. There seems to be at least six ways in which we might improve crop production :—

(1) We can hope for further improvements by the use of new varieties capable of making better growth than those ordinarily cultivated. Plant breeders all over the world are attacking this problem with much success, and many of the new sorts show considerable promise.

(2) Much can be done by control of plant diseases. Unfortunately we have no means of knowing how much is lost each year by pests of disease, but it is undoubtedly considerable. Laboratories for studying plant pathology have been set up at Rothamsted and elsewhere, and we are hoping to achieve good results ; much valuable information has already been obtained.

(3) We are also looking to the tractor to achieve great things on the farm. It will allow considerable development of cultivation implements, enable us to improve our tillage and to keep down weeds, a very serious trouble in the southern part of England. Good Scottish farmers in that region have told me that farming in Scotland is much easier than in England, because the rigorous northern winters keep weeds in check, while the mild southern winters encourage their growth.

(4) It is possible that certain substances, such as boric acid, the fluorides, etc., studied by GAUTIER and CLAUSSMANN in France, may help in raising crop growth.

(5) It is possible also that special methods may prove of value, such as the high-tension discharge tested by MISS DUDGEON at Lincluden, Dumfries, and ably and critically studied by PROF. V. H. BLACKMAN.

(6) Finally, it seems probable that some wholly new method may be found for increasing crop growth. In most civilised countries there are now research institutes where the ways of plants and the properties of soils are being studied. Men of science, as a rule, do not care to risk prophecies or to attempt to create sensations, and I certainly am not going to break this wholesome rule. Something, however, has already been done ; in spite of the decreased labour spent on cultivation, the yields tend to go up, while the new knowledge that is now being gained is adding greatly to the pleasure of farming and giving both masters and men an interest in their work that they never had before.—NATURE, Vol. 108, No. 2708.

THE VALUE OF SOIL ANALYSES TO THE FARMER.

F. B. GUTHRIE AND R. M. PETRIE.

There is, and always has been, much difference of opinion regarding the value to the farmer of an examination of his soil. On the one hand, the view has been expressed that the chemical composition of the soil is a reliable guide to the nature of the manuring required. On the other hand, opinions equally emphatic have been voiced that an examination of the soil (usually called soil analysis) is not only of no value but positively misleading.

The trouble is probably due to the use of the term "soil analysis" and the different interpretations placed upon it. Those who believe that an analysis of the soil consisting only of the determination of the chemical plant-food is no guide to the manurial requirements of the soil are perfectly correct. This view of the matter was expressed by one of us (F.B.G.) as long ago as 1895, when, in an address before the Australasian Association for the Advancement of Science in Brisbane, it was pointed out that an examination of a soil, to be of any benefit to the farmer, should take into account the texture of the soil, its behaviour towards water, etc., thereby suggesting means by which any defects might be ameliorated, and by which the soil might be brought into the most fertile condition possible and into such a state that it could utilise to the best advantage any manures added.

This fact has been borne in mind in connection with soil examinations carried out by the Chemist's Branch of the Department ever since, and recommendations for manuring are never based on the quantities of nitrogen, potash, and phosphoric acid present in the soil. In fact, determinations as to quantities of these constituents are seldom made, and only in cases where the applicant expressly desires such information, or where the information is required for such scientific purposes as fixing different soil types, or for our own information. Out of 246 soils examined during the last twelve months, these determinations have only been made in twenty-one cases. Manures are recommended as the result of departmental experience with the different crops in different districts.

The examination of soils as conducted by this branch of the Department is more in the nature of an investigation than an analysis, the object being to reveal to the farmer the defects in his soil, such as sourness, stiffness, presence of plant poisons, lack of humus (organic matter) or of lime, etc., and to advise as to proper treatment, in order that benefit may be derived from subsequent manuring. Such a soil analysis is of value in determining changes which take place in the soil under certain conditions, and in comparing one soil with another, all of which work assists in the study of the effect of changing the physical condition and the effect of cropping. The knowledge so obtained can later be practically applied to help the farmer to obtain better and larger crops.

The usefulness of a laboratory examination (so-called analysis) of a soil lies in the indications it affords as to sourness, alkalinity, presence of excess of salt, poor water-holding power, lack of humus, lack of lime, need for drainage, imperviousness to the passage of water, tendency to set hard on drying, presence of hard-pan, presence of toxic substances, suitability to different crops, general poverty in plant-food, excessive proportion of any ingredient such as clay, sand, peat, or stone, and power of nitrification.

The determination of the percentage amounts of the plant-foods nitrogen, phosphoric acid, and potash does not afford any information under the above important heading, is in any case a process too laborious to be carried out

invariably, and is only made in the exceptional cases mentioned previously. It is no guide whatever as to the nature of any necessary manuring, which depends in the first place on the nature of the crop, and (in a lesser degree) on the district and the climate. Neither is it any guide as to the suitability of the soil for different crops.

Soil examinations on the rational lines described, and as carried out by this branch, should always precede recommendations for manuring, as it would be quite idle to expect manures to exercise any benefit on soils possessing some of the physical defects enumerated. That such an examination is of value is evidenced by the very considerable number of soils forwarded for examination.

It is a matter for regret that there is no soil survey branch of the Department of Agriculture in this state as in other countries. Such a branch could establish type-soils in different districts, and refer soils under examination to one or other of such types, the characteristics of which had been previously established. Such surveys would be of very great advantage in determining the nature of the different soils in areas to be subdivided into farms, and in valuing the soil from the point of view of its agricultural possibilities. All such subdivisions should be preceded by a soil survey properly carried out.

AGRIC. GAZ. OF N.S.W., VOL. XXXII, PART 9.

THE PRODUCTION OF ARTIFICIAL FARM-YARD MANURES.

In the last number of the JOURNAL OF THE MINISTRY OF AGRICULTURE (p. 398), there appeared an article on this subject which deserves the attention of practical agriculturists. The results obtained constitute one of the most notable advances in knowledge of the principles of agricultural practice that have been made in recent years.

Interesting as the subject of "artificial" farmyard manure must be—especially for the market gardener—the advance in knowledge regarding the principles which underlie farm practice in relation to ordinary yard manure is equally noteworthy. It is now made clear that Nature, if left to herself, turns out a product which is practically of constant fertilising value. The making of dung is essentially a process for rotting straw. The latest advance of science confirms the wisdom of age-long practice—the addition of animal urine is the best way of rotting straw and producing the most essential of all fertilising agents. So much for theory, what of practice?

The discoveries that have been made establish, first of all, that under *ordinary* conditions of making and application it makes little difference whether dung is made from "cake fed" animals or not. A certain quantity of straw will give a certain amount of dung of a uniform fertilising value, and, secondly, if, as a result of feeding cake, the animals produce a richer urine, the best way of retaining the added richness during the period that ordinarily elapse between making (*i.e.* thorough rotting) and application, is to *use more straw in the litter*. Unless this is done the additional fertilising value (nitrogen) may be lost in the air.

In fact, it would seem to follow that there is no necessary connection between the richness of the food consumed by farm stock and the value of the resulting dung as a fertiliser after storage for several months in the manner usually practised, *unless an adequate quantity of straw has been supplied as litter*. That is to say, the more or richer the food used, the greater must be the amount of straw used as litter, otherwise the increased

fertilising value of the excrement is likely to be lost. If further investigation confirms this view, existing practice relating to farm valuations may have to be modified.

Next, the discoveries made by MESSRS. HUTCHINSON AND RICHARDS point to a method whereby the ever-increasing shortage of farmyard manure may possibly be met. They have shown how it is possible to produce from straw a material which has the appearance and most of the properties of the natural product. Their investigations render the process an orderly one; the quantities of the various materials to be used, and the conditions under which successful results will be obtained, are laid down precisely.—JOURN. MIN. OF AGRIC., VOL. XXVIII, No. 6.

EFFECT OF THE DROUGHT ON FERTILISERS IN THE SOIL.

In a season so exceptional as the one now drawing to a close there has necessarily been much experience with fertilisers that was wholly unexpected. In many cases land was well manured for roots, but no roots grew; elsewhere much fertiliser has been put on grass land with no effect. The question therefore arises, to what extent can fertilisers added to the soil in seasons such as the present be relied upon for next year's crops?

There is abundant evidence to show that *Potash* and *Phosphates* remain unchanged during a dry season, and they will therefore come in perfectly well for succeeding crops in the rotation: no loss need be feared. The fertiliser added has not been wasted, but is simply lying where it can be taken up by the plant. This holds true of sulphate of potash, muriate of potash, kainit, superphosphate, basic slag, mineral phosphates and bone manures.

Nitrogenous manures, however, are liable to behave differently. Some of them have probably been taken up by the crop, and, if so, they cannot of course be expected to act in the soil again. Cases have come to the writer's notice where a quick-acting nitrate was taken up by the grass crop, as shown by the dark green colour and additional growth of the herbage; while the slower acting nitrolim was not taken up, but lay on the soil unchanged. Nitrogenous manures left thus unabsorbed will probably change rapidly to nitrates when the soil becomes sufficiently wet, and they may then be taken by a crop, or washed out of the soil; but they are not likely to be left unchanged in the soil. So much depends on local conditions that it is difficult to lay down general rules; the following, however, will probably not be far wrong:—

1. On grass land intended for hay the nitrogenous manure will probably remain effective for the coming season. It has happened after a great drought that heavy rain was followed by an unusually copious growth of grass.

2. On arable land intended for winter corn the nitrogenous manure may also remain effective, especially in view of the fact that work is well forward and sowing is likely to be early.

3. On arable land intended for roots or spring corn, on the other hand, the nitrogenous manure may suffer considerable loss. It is likely to change into nitrates rapidly if it is not already in that form and then it is liable to be washed out of the soil. If the winter should be wet there will be just as much need for nitrogenous manure next spring as if this season had been an ordinary one. This statement, however, does not apply to potash and phosphates, which are not liable to be washed out, except perhaps from very light sandy soils under heavy rainfall.—JOURNAL OF MINISTRY OF AGRICULTURE, Vol. XXVIII, No. 7.

PESTS AND DISEASES.

BROWN BAST.

[*Department of Agriculture, Ceylon—Leaflet No. 12 (Revised.)*]

The following is a revised reprint of Leaflet No. 12 which appeared in the Tropical Agriculturist for June, 1919 :—

Brown Bast is a disease which attacks the cortex of the rubber tree (Hevea), practically always on tapped trees.

The first symptom of the disease is that the tree becomes "dry," the tapping cut ceasing to yield latex. Sometimes only part of the cut goes dry, and in such cases the latex often coagulates when it first meets the dry part and blocks the cut, so that the latex which exudes later runs down the stem, instead of flowing down the cut to the vertical channel.

Examination of the affected cut shows that the part which is not yielding latex is grayish-yellow, and dotted with pale brown, or brownish-yellow, spots and streaks. It may also be somewhat sodden and watery, and exude a watery fluid when pricked. In well-defined cases a continuous brownish line is found running along the cut very near the cambium. Behind this line the cortex still yields latex, and if it is pricked latex will issue from this inner layer; hence the fact that a tree yields latex when pricked is not evidence that it is not attacked by Brown Bast. This latex, however, lies too deep, as a rule ; to be obtained by ordinary tapping. Brown Bast should be suspected, if the cooly has to tap deeper than usual to obtain latex.

When the cortex beneath the tapping cut is scraped or pared away, it is found to be yellowish-gray, with grayish streaks and patches, and, here and there, red-brown streaks and spots. No latex exudes until the scraping reaches to about two millimetres from the cambium.

The disease may begin at or below the tapping cut, or at the collar. In Ceylon it appears that it most usually begins below the tapping cut, and that the cooly cuts into the diseased patch as tapping proceeds downwards.

If left untreated, the disease may take either of two courses. In the one case all the diseased tissue external to the continuous brown line dries up and is cut off as a thick, usually hard, scale leaving only a thin layer of laticiferous cortex, one or two millimeters thick, overlying the cambium. When the scale is prized off, the underlying layer appears to be healthy, but on scraping it one finds that it is speckled internally. Subsequently, as it grows in thickness, it develops nodules, and the tree becomes untappable. The dead scales are at first usually very hard and brittle, but they become soft and friable later.

In the other case no dead scale is formed, but the nodules are produced in or just beneath the diseased cortex.

The final result of an attack of Brown Bast is the production of nodules. It does not, however, follow that all nodules are the result of Brown Bast. Nodules are formed round abnormal regions in the cortex. One of the causes of such abnormal regions is the disease known as Brown Bast.

Hence nodules succeed an attack of Brown Bast. They are a consequence, or a secondary feature, of Brown Bast, although, if it were not for their development, the disease would not be so serious.

Brown Bast may begin at the collar, or in the lower part of the stem, and extend downwards along the tap root for a length of two feet or more, and also along the lateral roots. It is often confined to the part of the circumference which is being tapped, and usually does not cross the vertical channel.

There are no indications of the disease in its earliest stages. Sometimes the latex becomes very thick and coagulates on the cut. The first indication is usually the stoppage of the flow of latex; but this should not be accepted as a sign of Brown Bast, unless the cortex is discoloured. After scales have formed, they may crack longitudinally, but, as a rule, they do not fall off.

Three methods of treatment have been adopted for Brown Bast. They all have the same aims, viz., the removal, or destruction, of the diseased cortex to such a depth that any diseased tissue is destroyed and the formation of nodules prevented.

STRIPPING.

This method is officially recommended in Malaya. The whole of the affected cortex is stripped off, down to the wood.

Ascertain by light scraping how far the disease extends. With a sharp knife isolate this area with vertical and horizontal cuts, which extend to the cambium, including a margin about one inch wide of healthy tissue.

Shave the isolated area to about half the thickness of the cortex. Carefully lever up the lower edge with a knife, taking care to press on the cambium as little as possible, and then take hold of the free edge and peel off the whole of the shaved cortex.

The stripped surface must not be touched, nor exposed to direct sunlight, nor to rain. Hence it must be protected from sunlight and rain by cadjan or other screens. Whatever screen is used, it must not touch the stripped surface. Cadjan screens, or grass screens braced with bamboo, about three feet by two feet, are convenient.

The stripped surface may be protected against damage by rain, insects, or fnngi by covering it with paraffin wax. This is melted over a portable fire, and sprayed on with a garden syringe. The wax should not be heated until it begins to crackle. When filling the syringe, it should be drawn up and ejected once or twice to warm the syringe and prevent solidification in it. It is still necessary to screen the stripped surface, if it is exposed to direct sunlight so that the wax may be melted, especially along lateral roots. When the bark has renewed, the wax may be collected, melted down, and used again.

In about ten days the stripped area will be covered with a layer of renewed bark, and the screen may then be removed.

Stripping cannot be done when the tree is wintering, and it should not be done during dry weather or heavy rains.

SCRAPING.

The deceased cortex is shaved until latex begins to exude, and is then painted with Brunolinum Plantarium. As the scraping will, in general,

leave some of the diseased tissue remaining, the Brunolinum should be used as strong as possible. The strength which can be used without causing wounds must be determined by trial; estates apparently differ in this respect. Twenty per cent. should be tried first. If this causes wounds when applied immediately after scraping, application on the day after scraping should be tried. If the twenty per cent. solution does not cause wounds, the strength should be increased. Fifty per cent. solution has been used without injury.

When the cortex dies back after scraping and application of Brunolinum, it does not necessarily follow that the death of the cortex is due to the Brunolinum. One or two trees should be treated by scraping only, to see what happens when the Brunolinum is not applied. It must also be borne in mind that it will not be possible in all cases to make a diseased tree "as good as new."

TARRING.

The following method has been reported to give favourable results in Java :—

The extent of the diseased patch is ascertained by light scraping, and it is then isolated by deep horizontal and vertical channels, including a margin of an inch or two of healthy bark. The patch is then shaved to half the thickness of the cortex, and painted with hot coal tar, heated until it begins to bubble.

If the disease extends into the renewing cortex, this should have the outer brown layer only removed, and then tarred. To avoid wounds, cold tar should be used for renewing bark.

In cases where a thick brown scale has formed, the scale should be prized off. If the stripping method is used, the underlying layer is stripped in the usual way; but if scraping methods are being used, this layer should be treated with Brunolinum, fifty per cent. if possible, without scraping.

In old cases, where nodules have already formed the nodules should be cut out in the usual manner, and the wounds painted with twenty per cent. Brunolinum Plantarium, or tarred. In such cases wounds will inevitably be caused where the nodules have become united to the wood.

The whole of the area affected with Brown Bast must be treated, including the tap root and the lateral roots. Where the roots have been treated, the holes must be left open and drained so that water does not lodge against the treated patches. If they can be spared, trees which are badly affected on the roots should be cut out.

Resting affected trees does not cure Brown Bast.

T. PETCH,
Botanist and Mycologist.

February, 1919. Revised: October, 1921.

PLANT PEST AND DISEASE REGULATIONS, CEYLON.

Changes in the existing Shot-hole borer regulations have been approved by the Governor in Executive Council. Under the new regulations the prohibition of the removal of tea stumps and plants from areas infected with the Shot-hole borer pest of tea will be permitted under a permit issued by the Director of Agriculture. Any estates desirous of removing plants or stumps should upon application for permits of removal specify the number of plants or stumps such permit shall cover, the number of consignments and the estate to which the stumps or plants are being sent.

THE "BUNCHY TOP" PLANTAIN DISEASE.

Department of Agriculture, Ceylon—(Leaflet No. 18.)

This disease first appeared in Ceylon in the Colombo District about the middle of 1913. For some time it was confined to the Colombo District, but it has gradually spread, and is now found in the Panadure and Horana districts, in the Rambukkana plantain area, and in the Central Province up to an elevation of 3,000 feet. It is probably prevalent in other districts, and most likely occurs over a considerable area of Ceylon. In 1918 a plot of Manila hemp (*Musa textilis*) at the Peradeniya Experiment Station was practically destroyed by this disease. Bunchy Top has been known in Fiji, Australia, and Egypt for many years, and more recently has been reported from the Bonin Islands.

Symptoms: *Suckers.*—The symptoms of Bunchy Top are very marked, and the disease is therefore easily identified. The name Bunchy Top exactly describes the disease, the young suckers of a diseased plantain having their leaves bunched together at the top. The illustration gives a good idea of the general appearance of diseased suckers. It will be seen that these are dwarfed, *i.e.*, they fail to grow in height. As a rule, they grow to between 2 and 5 feet, growth in height being arrested at the time the leaves begin to bunch together. The tall stem in the illustration has grown normally, and completely overtops the three diseased suckers. In Ceylon diseased suckers never mature and never produce fruit.

Leaves.—The bunching together of the leaves is produced by the failure of the leaf stalk to grow in length. The leaves are thus not carried away from one another, but remain closely packed in a rosette, giving the sucker an appearance somewhat like a shaving brush. At the same time the leaves are much smaller in size. They are lighter in colour, usually a very pale green, often becoming paler toward the margins, which in some cases are quite white. These leaves are very brittle, and easily break when gently folded longitudinally. In this respect they differ markedly from the leaves of healthy suckers, which are soft and pliable. As the diseased leaves become older, they become thicker in transverse section, and develop a strongly ridged or corrugated surface.

Bulbs.—A healthy plantain bulb when cut open is absolutely white in colour. The bulb of a Bunchy Top plant, however, shows small flecks and lines of a yellow or brown colour. These are scattered throughout the interior of the bulb, and vary considerably both in size and number. Frequently the banana root borer (*Cosmopolites sordidus*) tunnels the bulbs causing considerable damage, but it is also found in suckers which are not affected with the Bunchy Top disease,

Roots.—The roots of Bunchy Top plants are to a great extent dead. The larger roots are apparently killed back from the root tip for a considerable distance, but the portions adjoining the bulb are usually still living. The finer roots are all dead, and it is rare to find any finer roots still living.

Cause of the Disease.—In the living portions of the roots nematodes (eelworms) sometimes occur, giving rise to typical nematode galls or merely causing a slight local swelling. It is possible that two species of nematodes are concerned. It is improbable that these cause the disease, as they are not invariably present on Bunchy Top plantains. On both the finer and the larger roots a fungus—Rhizoctonia sp.—is prevalent, and it is possible that this is the cause of the disease. Evidence, however, is not yet complete enough to attribute the disease solely to this fungus. A preliminary experiment to determine whether the disease is caused by a filterable virus indicates that it is not so caused, or else that the virus, if present, is not extremely infectious.

A. NORMAL SHOOT. B. C. D. BUNCHY TOP SUCKERS.

Spread of the Disease.—The disease has probably been spread from district to district through the exchange of plantain suckers for planting up purposes. Bulbs of diseased suckers could hardly fail to be included amongst consignments of healthy suckers, and thus Bunchy Top has been introduced into new areas. The disease having been introduced into a district, it may possibly be spread throughout the district through the agency of the banana root-boring weevil. This tunnels the bulb, and any migration from a diseased bulb to a healthy one would render possible the transference of the disease, through minute particles of diseased tissue adhering to the body of the insect.

Treatment.—It has been found that Bunchy Top is much more prevalent in plantain fields that have been allowed to run on for several years from the date of planting up. The bulbs of these old, long-standing stools are further badly riddled by the root-boring weevil. It would, therefore, be advisable to dig up and remove all the bulbs of old stools and replant with carefully selected and healthy suckers at about 3-year intervals. The interval should be as short as possible, due allowance being made to permit of a fair financial return from each planting up. Where Bunchy Top suckers occur the whole stool affected should be dug up completely, and the bulbs, stems, and leaves should be removed from the field and buried with lime, or, if possible, dried and burnt. The spot from which the diseased plant is removed should be heavily limed, and should be left vacant for at least one year before re-planting with plantains.

In view of the occurrence of the Rhizoctonia fungus on the roots of diseased plants, it is of interest to note that in India, where jute suffers severely from attacks of Rhizoctonia, it has been demonstrated that the application of potash manure both produces a much heavier crop and greatly reduces the incidence of the disease. In the Bonin Islands, further, Bunchy Top is attributed to deficiency of potash in the soil, and it has been found that application of potash manure greatly reduces the number of Bunchy Top suckers, and even enables transplanted diseased suckers to recover. In both India and the Bonin Islands a nitrogenous manure was applied with the potash manure in the experiments, which gave the heaviest yield and greatest reduction in the incidence of disease.

The treatment recommended may, therefore, be summed up as—

(1) Replanting of fields with healthy suckers about every three years.

(2) Immediate removal and destruction of all parts of diseased plants.

(3) Application of a nitrogen, potash, and lime manure. It is recognized that in small gardens it will generally be impossible for the owner to make any considerable financial outlay on manures. To meet this case it is suggested that a liberal dressing of wood ashes be forked in round each plantain stool at least once every year. To supply the nitrogenous manure a mulch of leguminous plants could be applied.

Immune Varieties.—It is not as yet known whether any of the Ceylon plantains are immune to Bunchy Top disease, and information from plantain growers would be welcomed on this point. In this connection it has been observed in Fiji, where the Gros Michel (or Jamaica) banana and the China banana are grown, that the Gros Michel banana is immune. The plantain industry in Fiji was practically destroyed by this disease between 1890 and 1900, but at the present day, with improved methods of disease control and cultivation, plantain growing there is again a profitable industry.

G. BRYCE,

October, 1921. Assistant Botanist and Mycologist.

DESTRUCTIVE INSECTS AND PESTS ORDER (U.K.) OF 1921.

MINISTRY OF AGRICULTURE AND FISHERIES.

The Destructive Insects and Pests Order of 1921, which comes into force on the 1st October, 1921, prohibits the landing in England and Wales, from any country other than Scotland, Ireland and the Channel Islands, of the following categories of plants, seeds etc., unless each package in the consignment has attached thereto a copy of a certificate issued at the time of packing by a duly authorised official of the country from which it is exported :—

All living plants with a persistent wood stem above ground, and parts of the same, except seeds, when for use in propagation—such as fruit trees, stocks and stools, forest trees, and ornamental shrubs and grafts, layers and cuttings thereof ; all potatos ; and all tubers, bulbs rhizomes, corms, and hop stocks for planting ; seeds of onions and of leeks for sowing, and gooseberries.

The inspection must be made not more than 30 days prior to the date of despatch, and the certificate must state that the plants, seeds, etc., are healthy as regards common pests generally and particularly the following :—

Fruit tree Cankers (produced by Nectria ditissima, Tul, or any species of Monilia).

Silver Leaf (Stereum purpureum, Pers.).

Black Currant Mite (Eriophyes, Ribis, Nal.).

Wooly Aphis (Eriosoma Lanigerum, Hausm).

All scale Insects (Coccidæ).

Brown Tail Moth (Nygmia Phoeorrhoea, Dan.) Euproctis (chrysorrhoea)

Rhododendron Fly (Leptobyrsa Stephanitis) rhododendri, Horv.

Potato Blackleg (Bacillus atrosepticus, Van Hall.)

American Gooseberry Mildew, (Sphaerotheca morsuvae, Berk). and also that they are free from the insects and pests specified below :—

Fungi.

Black Knot of Plum and Cherry (Plowrightia morbosa, Sacc.)

Pear Blight (bacillus amylovorus, De Toui.)

Chestnut Canker (Endothia parasitica,) (Murr.) Ander and Ander

Wart Disease of Potatos. Synchytrium endobioticum

Onion and Leek Smut (Urocystis cepulae, Frost).

Downy Mildew of Hops. (Peronoplasmopara humuli, Miy, et. Taka.)

INSECTS.

Vine Louse (Phylloxera vastatrix. Planch).

American Apple Capsids (Heterocordylus malinus, Reut, and Lygidea mendax, Reut).

Pear Tinged (Stephanitis, pyri. Fab).

Colorado Beetle (Leptinotarsa decemlineata, Say).

Plum Curulio (Conotraehelus nenaphar, Herbs.).

Potato Moth (Phthorimaea operculella, Zell).

American Luckey Moths (Malacosma americana, Fab and M. diastri Hubn).

Oriental Fruit Moth (Cydia molesta, Busck).

San Jose Scale (Aspidiotus perniciosus, Comst).

Japanese Fruit Scale (Diaspis pentagona, Newst).

Apple Fruit Fly (Rhagoletis Pomonella, Welsh).

Cherry Fruit Flies (Rhagoletis cerasi, Linn., R., cingulata, Loew, and R. fausta, Osten, Baken).

Gooseberry Fruit Fly (Epochra Canadensis, Loew.)

PROCEDURE TO BE FOLLOWED BY CONSIGNORS.

Persons sending to England and Wales consignments including any of the categories indicated in the first paragraph should take steps to ensure the inspection of the consignment by a duly authorised government official and obtain from him a certificate in the following terms :—

SPECIMEN CERTIFICATE.

CERTIFICATE OF EXAMINATION OF PLANTS, Etc. No.....

This is to certify that the stock included in the package or consignment described below was thoroughly inspected by

.....

an Inspector of ....., on .....

.....; the stock was grown by

.....

at .....

and was found, or believed by the Inspector, to be healthy and free from any of the plant diseases or pests named in the Second Schedule to the above Order.

(Signed).....

(Official Status).....

.....

Number and Description of packages in Consignment..... Distinguishing Marks

Nature of Contents.....

Name and Address of Exporter.....

Name and Address of Consignee.....

Name of Vessel.....

Port of Shipment.....

Port of landing in England and Wales.....

Approx. date of arrival.....

This Certificate should be forwarded to the Horticulture Division, Ministry of Agriculture and Fisheries, Whitehall Place, London, S. W. I. at the time of issue. A copy must be affixed to each package in the consignment.

As indicated above the inspection must be made not more than 30 days before the date of dispatch. The certificate itself should be forwarded to the Horticulture Division, Ministry of Agriculture and Fisheries, Whitehall Place, London, England. Consignors should note that consignments arriving in England and Wales without the copy certificate attached to the packages will be detained at the port of entry and will not be admitted into the country until they have been examined by an official of the Ministry of Agriculture and Fisheries and found to be healthy generally and especially free from the specified insects and pests. Consignments which are found to be unhealthy will be either disinfected, destroyed, or returned to the country of origin.

POTATOS.

In the case of potatos, other than new potatos, (i.e. potatos landed in England and Wales, on or before the 31st day of July in the year in which they have been lifted) the certificate must also declare that Wart Disease has not occurred on the place where the potatos were grown nor within 500 yards thereof (approximately half a kilometre). New potatos must be accompanied by a declaration in writing by the exporter stating that they have been lifted in the current year.

INSECTICIDES AND FUNGICIDES.

Horticulturists are probably aware that, at the request of the Chamber of Horticulture and an important section of insecticide and fungicide manufacturers, a Bill has been drafted for the regulation of the trade in certain of the chemicals most generally in use for the control of pests, and especially for ensuring that the grower should have at his disposal fungicides and insecticides of guaranteed composition. In view of Cabinet instructions on national economy it has proved necessary to postpone the introduction of this Bill to Parliament, but it is believed that many manufacturers are prepared to meet the terms of the Bill without previous legislation, and it has therefore been decided to publish certain of the more important provisions both for the information of the public in general and the manufacturers in particular. Purchases of insecticides and fungicides of kinds mentioned below are earnestly advised to stipulate before taking delivery that the articles supplied should comply with the conditions laid down.

These conditions and the articles to which they apply are as follows :—

1. Lead Arsenate Paste.—(a) The total amount of arsenic in lead arsenate paste as sold for agricultural and horticultural purposes shall not be less than 14 per cent. of the paste in the condition in which it is sold, nor less than 28 per cent. of the paste when dried at 100°C., the arsenic being expressed in terms of arsenic oxide ($As_2 O_5$).

(b) The amount of water-soluble arsenic in the paste as sold shall not exceed 0·5 per cent., expressed as arsenic oxide ($As_2 O_5$).

(c) The actual percentage of arsenic in terms of arsenic oxide ($As_2 O_5$) in the paste as sold shall be stated on the label together with the dilution required to produce a standard spraying mixture containing 0·1 per cent. of arsenic oxide ($As_2 O_5$).

(d) The amount of substance other than arsenate of lead and water in the paste as sold shall not exeed 3 per cent.

Note.—So far as the purchaser is concerned the most important provisions are these *b*, *c*, and *d*, above, and he should realise the reasons for them. As regards *b*, arsenic in a water-soluble form is very likely to cause injury to foliage, and its presence in lead arsenate spraying compounds has at times resulted in serious losses. It is therefore necessary to prescribe that the water-soluble arsenic contained in a paste should not exceed a certain percentage which has been shown to be harmless.

Regarding *c* lead arsenate paste consists primarily of mixtures of lead arsenates and water, some containing more water, others less. It is evident, therefore, that if all makes of lead arsenic are diluted to the same extent the resulting spray fluids may be either too weak or unnecessarily strong. The purchaser clearly should know the "strength" of the paste he is buying and to this end it is laid down that the label on the container should state the percentage of arsenic which the paste contains, and as this must be stated in chemical terms which may not be clear to all, it must also be stated what dilution is required to make up a standard spraying mixture containing 0·1 per cent. of arsenic oxide. Such a mixture may be regarded as effective under all conditions although for use against young caterpillars it may be unnecessarily strong. There is no difficulty, however, in diluting it to make a $\frac{3}{4}$ standard mixture. Thus in the case of a paste containing 20 per cent. of arsenic oxide, the standard mixture consists of 1 lb. of paste to 20 gallons of water, but $\frac{3}{4}$ lb. to 20 gallons may be used early in the season against small caterpillars,

In any case a standard mixture may be obtained by adding 1 lb. of paste to a number of gallons of water equal to the percentage of arsenic oxide—1 lb. to 20 gallons, with a paste containing 20 per cent., 1 lb. to 15 gallons with a paste containing 15 per cent., and so on.

In the case of *d*, when lead arsenate paste is purchased, the article should obviously not consist of some other arsenate, as for instance calcium arsenate. It is therefore laid down that apart from water, the total impurities in the paste should not exceed 3 per cent.

2. **Lime-Sulphur (Solution of Sulphides of Calcium).**—(a) Lime-sulphur solution as sold for agricultural and horticultural purposes shall be made from lime, sulphur, and water only.

(b) The specific gravity of the solution as sold shall not be less than 1·3 at 15°C.

(c) The solution shall be free from suspended matter and shall remain clear at all dilutions.

Note—Lime-sulphur from the chemical standpoint is exceedingly complex, but it is clear that the purchaser should obtain only lime (calcium) and sulphur in the solution (requirement *a*). He should also know that he is getting an article sufficiently strong to make an effective spray fluid at the dilutions usually advised (requirement *b*). Finally, since the active

chemicals in the solution are all soluble he should not be sold a proportion of inactive "sediment" or "sludge" (requirement *c*).

3.—**Nicotine.**—It is proposed to deal under the Bill with nicotine when sold as such, but the exact requirements are still under discussion. Purchasers of nicotine should, however, note that while the term nicotine is properly applied to *the chemical in its free or uncombined state*, it is sometimes used by sellers for combinations of nicotine with an acid—e. g., nicotine sulphate. Nicotine sulphate is an excellent insecticide, but it depends for its action on the nicotine it yields, and this nicotine must be released by mixing it with an alkali or spraying soap (which is sufficiently alkaline). Further, a nicotine sulphate spraying solution can only be valued by the percentage of free nicotine it yields and not by the percentage of nicotine sulphate. It is therefore important to purchasers of nicotine that they should have a statement from the sellers as to (1) whether the article is free nicotine or nicotine in combination, such as nicotine sulphate, and (2) the percentage of free nicotine in the article, or if the latter contains nicotine in combination, the percentage of free nicotine which will be produced on treatment with an alkali.

4.—**Copper Sulphate.**—Copper sulphate sold for use in a spraying mixture shall contain not less than 98 per cent. of crystallised sulphate of copper ($Cu\ SO_4\ SH_2O$).

Note—No comment is needed on this requirement, as it is obvious that if a purchaser needs copper sulphate for making a fungicide, he requires it free from impurities such as "green vitriol."

5.—**Soft (Potash) Soaps.**—(a) Not less than 95 per cent. of the total alkali present in soft—that is, potash—soap sold for spraying purposes shall consist of potash.

(b) Soft, or potash, soap sold for spraying purposes shall bear a label giving separate percentages of (1) the fatty acids, and (2) the resinous acids, which the soap contains.

Note—Soaps used for spraying are almost always "soft soaps," and typically such soaps are made by the combination of potash with a fatty acid. Some "soft" soaps may, however, contain considerable proportions of less valuable forms of soap—as, for instance, that produced by the union of soda with a resin acid. Potash being more expensive than soda, there is always a tendency in the cheaper soft soaps to introduce soda-resin soaps, which have the disadvantage of producing a most objectionable curd with water which is at all hard, blocking the spraying tackle and reducing the efficacy of the spray fluid. It is therefore essential that growers should be able to purchase potash (soft) soap with the guarantee that it is really made with potash, and the knowledge that fatty acids have not been replaced by resin acids.

6.—**Liver of Sulphur.**—(a)* An article sold as "liver of sulphur" shall consist of a mixture of salts of potassium, chiefly sulphides.

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* The Ministry is anxious that this recommendation should not in any way discourage the use of the sulphides of sodium. Since the action of either potassium or sodium sulphide depends on the sulphur and not on the potassium or sodium, it is undesirable to discriminate in any way against the sodium compound. When the time should come for proceeding with the proposed legislation this point will require further consideration in conjunction with the industries concerned; in the meantime it is desired to present the recommendations as nearly as possible in the form in which they were agreed.

(b) It shall conform to the characters and tests given in the British Pharmacopœia 1914 for sulphurated potash; and shall contain not less than 42 per cent. nor more than 45 per cent. of sulphur as determined by the process prescribed in the British Pharmacopœia for the estimation of sulphur in sulphurated potash.

Note.—Liver of sulphur is now used less often than formerly, but nevertheless those who do purchase it should obtain the potassium salts as defined above and not the cheaper sodium compounds. This remark does not imply any comparison between the values of the potassium and other sulphides for spraying purposes, but is merely to point out that if a purchaser is paying for an article, he should be supplied with it and not with something else, which perhaps costs less to manufacture.

7.—**Sodium and Potassium Cyanides.**—(a) An article sold as sodium cyanide for agricultural and horticultural purposes shall be capable of evolving (when treated with an acid) not less than 56 per cent. of its weight as hydrocyanic acid.

(b) An article sold as potassium cyanide for agricultural and horticultural purposes shall be capable of evolving (when treated with an acid) not less than 43·7 per cent. of its weight as hydrocyanic acid.

Note.—In fumigating with hydrocyanic acid gas it is of the utmost importance that the dose shall be accurately calculated, and this of course is impossible unless the purchaser can obtain the "cyanide" practically pure. Purchasers should therefore insist on a guarantee in accordance with the above requirement. Sodium cyanide is almost invariably used, as it is cheaper and weight for weight gives off more gas than the potassium cyanide. The latter is included, however, in case any should still prefer it.

8.—**Formaldehyde.**—This substance is not at present within the scope of the proposed legislation, but it is desirable that it should receive mention here on account of its increasing popularity as a dressing for cereals against bunt, etc. Formaldehyde is often referred to as "formalin" which was originally the trade name applied by a German company to a 40 per cent. solution of formaldehyde. It is important now that under whatever name Formaldehyde is bought a guarantee should be obtained as to the percentage of Formadehyde in the solution supplied.—JOURNAL OF MINISTRY OF AGRICULTURE, Vol. XXVIII, No. 7.

IMPORTATION OF SUGAR-CANE INTO BRITISH INDIA BY SEA.

The revised regulations for the importation of sugar-cane into British India by sea are as follows :—

1. Importation from the Fiji Islands, New Guinea, Australia and the Philippine Islands is absolutely prohibited.

2. Importation from any other country is prohibited (a) unless accompanied by an official certificate that the sugar-cane has been examined and found free from cane borers, scale insects aleurodes, root disease (any form), pine-apple disease (*Thielaviopsis ethaceticus*), sereh and cane gummosis, that it was obtained from a crop which was free from Mosaic disease and that the Fiji disease of sugar-cane does not occur in the country of export ; (b) or unless the canes are imported direct by the Government Sugar-cane Expert for cultivation under his personal supervision, in which case an official certificate is required that the country of export is free from the Fiji disease of sugar-cane.

CEYLON AGRICULTURE.

MINUTES OF MEETING OF ESTATE PRODUCTS COMMITTEE.

Minutes of the fifth meeting of the Estates Products Committee of the Board of Agriculture held at the Experiment Station, Peradeniya, at 2-30 p. m on Thursday, November 10th, 1921.

Present :—The Hon'ble the Director of Agriculture (Chairman) : The Government Agent, Central Province ; The Government Botanist and Mycologist ; The Govt. Agricultural Chemist ; The Government Entomologist ; The Asst. Botanist and Mycologist ; The Asst. Entomologist ; the Hon'ble Mr. Graeme Sinclair, Lt.-Col. T. G. Jayawardene, Gate Mudaliyar A. E. Rajapakse, Major J. W. Oldfield, Dr. C. A. Hewavitarne, Messrs. H. D. Garrick, J. A. Coombe, J. Horsfall, George Brown, J. B. Coles, G. B. Foote, F. R. Dakeyene, C. E. A. Dias, J. P. Blackmore, C. P. de Silva, Thomas A. de Mel, and T. H. Holland (Secretary).

Visitors :—Messrs. M. Park and T. B. Ranaraja.

The Chairman stated that letters and telegrams regretting inability to attend had been received from the Hon'ble Messrs. James Peiries and H. L. De Mel, Sir Solomon Dias Bandaranaike, The Hon'ble the Government Agent, Western Province ; Messrs. M. L. Wilkins, D. S. Cameron, J. S. Patterson, W. R. Matthew, A. W. Beven, N. D. S. Silva, N. G. Campbell, and Lt.-Col. L. Bayley.

The Chairman announced that Messrs. J. Sheridan Patterson and C. P. de Silva had returned to the Island and resumed their seats on the Committee.

The minutes of the last meeting having been circulated among members were taken as read, and were confirmed.

Agenda Item 1. Progress Report of the Experiment Station, Peradeniya.

In reviewing this report the Chairman remarked that the coffee plots were on the whole looking healthy and the crops which were published in the report were satisfactory. There had been some disease on Robusta coffee but it did not appear to be serious.

The tea had practically all been pruned and had been cut back hard into the old wood.

MR. BRUCE FOOTE enquired how Gliricidia compared with Dadaps in the matter of root nodule development.

The CHAIRMAN promised to have this point investigated. He remarked that at Peradeniya the yield of green material from Gliricidia was considerably greater than that from Dadaps. MR. KELWAY BAMBER suggested making fresh analysis of lopped Gliricidia.

MR. J. B. COLES enquired if the coffees mentioned were all of the same age and thought that yields were of little value unless the ages were given.

The CHAIRMAN replied that they were all in full bearing but not exactly of the same age. He promised to supply details of the exact ages later.

MR. G. B. FOOTE stated that some Indigofera seed (the growth of which plant was favourably commented on in the report) which he had obtained from Darjeeling had produced very poor growth in Dolosbage and had been a complete failure in the Kelani Valley and Ratnapura. He enquired if the plant grew at certain elevations only.

The CHAIRMAN stated that the results obtained at Peradeniya were from locally raised seed. Seed had originally been imported from India.

MR. J. P. BLACKMORE enquired if any Dadaps were dying on the Experiment Station.

THE CHAIRMAN replied that none had died to his knowledge.

Agenda Item 2. Further consideration of the desirability of declaring Fomes Ustulina and Poria under the Diseases and Pests Regulations.

The CHAIRMAN stated that the subject had been considered at the last meeting of the Committee when it had been resolved to refer the matter to the Planters' Association and the Low Country Products Association for their opinion. He had received communications from both these bodies stating that neither of them favoured the declaration of the diseases in question under the diseases and pests regulations.

MR. G. B. FOOTE, who was the original mover of the resolution, said that he had been unable to attend the last meeting of the Committee and had been rather taken aback to see the subject on the Agenda. The matter had not been referred to the Kelani Valley Planters' Association, but this body were strongly of the opinion that the diseases should be declared. He gave instances of the great danger to many estates which were largely surrounded by small native holdings whose owners were now cutting out rubber to plant coconut and leaving the rubber lying about.

He felt inclined to ask that the matter be referred back to the Planters' Association.

MR. H. D. GARRICK said that he thought the Planters' Association had decided against the scheduling of these diseases largely under his guidance. He had gathered from the views expressed by the Chairman at the last meeting that the declaration of these diseases would be likely to rebound upon the planting community.

MR. THOMAS A. DE MEL said that the opinion of the Low Country Products Association had been that the diseases were so prevalent that no good could result from their declaration.

MR. GRAEME SINCLAIR enquired what the result of their declaration would be.

MR. PETCH replied that it would be necessary to insist on the clearing up of all logs, rotten wood, etc. in all rubber, coconut and other crops and burning them within a definite time. Estates would not be able to keep firewood for any length of time. It would be necessary to include all coconut estates under the regulations and the work entailed would be enormous.

He agreed with the Low Country Products Association that the diseases were so widely spread that the effect of proclamation would be negligible. If an estate left rotting timber lying about the disease would appear.

The CHAIRMAN stated that in his opinion these were domestic diseases. If an estate suffered it was because it had rotten timber lying about or dead stumps.

MR. GRAEME SINCLAIR said that he was against bringing in any regulations which it was impossible to enforce.

DR. C. A. HEWAVITARNE thought that the diseases were not severe enough to warrant such drastic action. He advocated publishing information about these diseases in the vernaculars for the benefit of villagers.

The CHAIRMAN agreed to this suggestion. He thought the line to be taken was mainly the education of small proprietors.

He did not think any useful purpose would be served by referring the matter back to the Planters' Association. If a disease was declared the Plant Pest Board concerned usually had no funds to deal with it and asked the Department of Agriculture to supply Inspectors.

After some further discussion MR. FOOTE decided to withdraw his resolution as the feeling of the meeting was largely against it.

Agenda Item 3. Disinfection of Imported Tea Seed.

This subject had been discussed at the last meeting and had been referred to the Planters' Association.

The CHAIRMAN stated that at a meeting on September 9th, the Planters' Association had unanimously passed a resolution in favour of the total prohibition of the importation of tea seed from India. This resolution was supported by the Ceylon Estates Proprietors Association.

MR. GRAEME SINCLAIR asked MR. PETCH's opinion.

MR. PETCH was in favour of prohibiting the import of tea seed. In answer to a question by MR. FOOTE, MR. PETCH said that the effect of an attack of Blister Blight in India was the loss of that season's crop, not the death of the bush. The disease had formerly been confined to Assam but had later been introduced into Darjeeling and since no other explanation could be found this infection must have taken place through the seed sent from Assam.

MR. GRAEME SINCLAIR thought that the suggested prohibition seemed rather too drastic. MR. H. D. GARRICK thought that there were enough diseases already in Ceylon and that it was undesirable to risk introducing any more.

MR. THOMAS A. DE MEL asked if steps could not be taken in India to prevent the movement of tea seed from one area to another.

It was pointed out that unfortunately the infected areas were the best tea seed garden areas.

The CHAIRMAN pointed out that the tendency of all countries was to prohibit the import of seeds and plants ; a large number of instances were cited.

A resolution to the effect that all imports of tea seed from India should be prohibited was then put to the meeting and was carried unanimously.

Agenda Item 4. Shot Hole Borer Regulations.

The CHAIRMAN in introducing this subject said that the present regulations often operated unfairly and were difficult to apply. There was a need for workable regulations. He would ask MR. JEPSON to explain the matter more fully.

MR. JEPSON briefly outlined the history of the regulations from 1914 onwards. The present position was that

(1) All infested estates must be registered.

(2) Plants may not be removed from an area registered as infested.

(3) Plants may be removed from estates not registered as infested.

The sole object of the regulations was to prevent the importation of the borer into the large tea growing area of which Dimbulla was the centre which was still free from the Shot-hole borer pest.

It was possible, however, that the object of the regulations might be defeated by the owner of a small garden in the midst of a heavily infested district, which was not registered owing to the presence of borer not being detected at the time of inspection, sending stumps, say, to Dimbulla.

On the other hand an estate registered as infested was not allowed to send stumps from a nursery, which might be far from other tea and free from borer, to an infested estate near by ; a proceeding which could result in no possible harm.

Some modifications of the present regulations were needed to remove these anomalies. MR. JEPSON was of the opinion that attention should be concentrated on keeping the free areas free, he thought this was possible. He exhibited a map showing the areas which were free from borer and the infested areas.

MR. GEORGE BROWN supported MR. JEPSON and pointed out that the present regulations were a premium on dishonesty.

The CHAIRMAN gave instances of the hardships caused by the present regulations and of the difficulties in working them.

MR. GRAEME SINCLAIR, MR. GEORGE BROWN and other members advocated allowing free interchange of plants on permits between infested areas, but the absolute prohibition of all tea plants into the free area.

The meeting were unanimously in favour of this policy.

Agenda Item 5. Report by the Mycologist and Entomologist on Tea Manurial Plots at the Experiment Station, Peradeniya.

The consideration of the Mycologist's report was postponed until the next meeting.

The Government Entomologist reported as follows :—

'A detailed inspection of the plots had been made before pruning, special attention being paid to Shot-hole Borer, tea termites, scale insects, Aphis and tea mites. Shot-hole Borer was generally distributed. Termites or white ants were more prevalent in the Assam Indigenous and Manipuri plots where good wood had been made than in the Single plots where the wood was poor. The species found was mainly that which worked on dead wood (resulting from branch canker or other causes) under a film of earth.

At the second inspection after pruning signs of injury by the Tea termites were detected. This species tunnels in living wood and is difficult to detect before pruning.

Apis was found on a few bushes in most plots.

Red spider was not common. Tortrix, Bag worm, Leaf roller and Leaf miner were found only on a few scattered bushes in a few plots. Nests of the large red ant were found in most of the plots and were a great nuisance to coolies.

Agenda Item 6. Experiments with New Economic Products.

The CHAIRMAN exhibited photographs of new Economic products which he thought would interest members.

The photographs showed limes in full bearing at Anuradhapura which had come into bearing at $3\frac{1}{2}$ years of age.

Further experiments with Sisal hemp were being started at Jaffna and Hambantota and would be started later at Trincomalie.

With regard to Oil palms, experiments were now being made with the expression of oil from the kernels. The oil was used in Africa for the purposes for which coconut oil was used in Ceylon and was exported for the manufacture of Margarine and soap.

Enquiries had been received for land for growing sugar-cane for the production of power alcohol, a possibility not so remote as some thought.

Enquiries had been received for 500 acres of land for pine-apples. The proof of the bulletin on Pine-apples was laid on the table. The Bulletin would shortly be ready for issue.

The Government had planted about 60 acres of cotton in the Hambantota district and seed sufficient for another 150 acres had been distributed.

With regard to limes MR. BRUCE FOOTE enquired whether a rainfall of over 150 inches was prohibitive for growing limes.

The CHAIRMAN said that they could be grown but where the rainfall was heavy the citric acid content would be low and profits less.

Agenda Item 7. The Grafting and Sclective Cultivation of Hevea.

This subject was placed on the agenda at the instance of MAJOR J. W. OLDFIELD and MR. C. B. FOOTE.

MAJOR J. W. OLDFIELD said he believed that certain experiments with grafting of rubber had been carried out in the Botanic Gardens. He asked if it would be possible to carry on experiments on an estate in Kalutara where a new clearing would be available.

MR. BRUCE FOOTE wished to enquire into the possibilities of seed selection and of starting seed nurseries in remote jungle sites where there would be no danger from cross fertilisation.

The CHAIRMAN stated that the experiments at Peradeniya had been started in 1919. The early efforts were not successful. A number of buds had been put on to nursery stumps every month in order to test the best months for the experiments. Out of 12 patch buds put on 12th September, 7 were still living. The Rubber Research Committee were prepared to send one of the Gardeners of the Department to Java to receive training in the methods employed there and were further offering a prize to the estate producing the best results. In Java, the most successful periods for budding were between the dry and wet seasons.

In response to a request for further publication the CHAIRMAN promised to have the circular published by the Rubber Research Committee reproduced in the TROPICAL AGRICULTURIST.

Agenda Item 8. The Cultivation of Lac.

DR. C. A. HEWAVITARNE in introducing this subject said that lac had formerly been successfully cultivated in Ceylon. He understood that it was a paying business in India and asked if it could not be re-introduced into Ceylon.

DR. J. C. HUTSON then gave a few particulars of the history of lac cultivation in Ceylon. Various more or less unsuccessful attempts to introduce the lac insect into Ceylon had been made by MR. GREEN. In 1911 the Agricultural Society had taken up the matter and sent an Agricultural Instructor, MR. N. WICKREMARATNE, to study the subject at Pusa. On his return he imported living lac insects and successfully started cultivation but the resulting crop was not available for further inoculation. A later importation in 1913 resulted in the production of good quality lac in several different localities. A quantity was successfully used by the Kandyan Art Association in lacquering articles. Further cultivation was continued up to 1916. The only pest which has so far proved troublesome was the red ant which broke the breathing filaments of the lac insects. A fresh consignment of brood lac was expected from India.

DR. HEWAVITARNE asked if the Committee were in favour of the resumption of experiments.

The CHAIRMAN promised to endeavour to reintroduce the cultivation of lac in those districts, notably Tangalle, where the methods were known.

Agenda Item 9. The desirability of Experiments to ascertain the Soil Constituents removed annually by a Crop of Nuts and by Toddy.

The consideration of this subject which stood in MR. A. W. BEVEN's name was postponed owing to his absence.

Agenda Item 10. The Necessity for Further re-afforestation by Tea Estates up-country.

MR. J. HORSFALL in introducing this subject said that the majority of estates at present took very little interest in this subject and the methods employed were usually very haphazard.

He wished to know if the Department of Agriculture or the Forest Department would supply information on scientific re-afforestation for firewood and on the growing of useful timber trees.

The CHAIRMAN replied that the question of forests was left to the Forest Department.

MR. HORSFALL complained of the absence of any connecting link between the Estates Products Committee and the Forest Department.

The CHAIRMAN said that on the question of selection and growing of useful timber trees it would be possible for the Gardens' authorities in co-operation with the Forest Department to draw up a leaflet giving the desired information.

With regard to the policy of the Forest Department the CHAIRMAN said that he was a member of the Committee appointed to consider this policy and would be glad to receive any suggestions from Planters.

Agenda Item 11. (a) The Improvement of the Quality of Coconuts by Manuring.

(b) Why on certain Estates does the Quality of Coconuts differ largely though the Soil analysis is the same.

The introducer of this subject MR. C. E. A. DIAS laid before members a printed table exhibiting the differences in the quality of nuts referred to above and giving analyses of the soils in question. At the request of several members the discussion was postponed to allow of further study of the tables.

MUDALIYAR A. E. RAJAPAKSE asked for details of rainfall, districts, and age of the trees. These were supplied by MR. DIAS.

T. H. HOLLAND,
Secretary,
Estates Products Committee.

FOOD PRODUCTION COMMITTEE, MATALE.

Minutes of a Meeting of the Matale Food Production Committee held on the 29th September, 1921, at 3 p.m. at the Matale Kachcheri.

Present :—The Assistant Government Agent (in the Chair), Messrs. G. Harbord, Divisional Agricultural Officer; C. P. Anderson, the 3 Ratemahatmayas of the District; Messrs. R. S. V. Poulier; c.c.s., M. B. Boange, V. G. Perera, Agricultural Instructors; and Mr. G. F. Abayakoon (Hony. Secretary)

Minutes of the previous meeting were read and confirmed.

Membership:—It was resolved that MR. R. S. V. POULIER, C.C.S., be elected a member of the Committee.

Rules re Paddy Cultivation Competitions:—The CHAIRMAN informed the meeting that for the purposes of these Competitions the Matale District has been divided into 6 areas as follows :—

(1) Matale South :—Matale Udasiya Pattu, Matale Medasiya Pattu, and Kohonsiya Pattu.

(2) Matale South :—Gampahasiya Pattu, Asgiri Udasiya Pattu and Asgiri Pallesiya Pattu.

(3) Matale East :—Matale Pallesiya Pattu and Ambanganga Korale.

(4) Matale East :—Laggala and Gangala Pattus.

(5) Matale North:—Wagapanaha Udasiya, Udugoda Udasiya and Udugoda Pallesiya Pattus.

(6) Matale North :—Wagapanaha Pallesiya Pattu, Inamaluwa Korale and Kandapalla Korale.

and that a 1st prize of Rs. 20/- and a 2nd prize of Rs. 10/- will be awarded for each area. Rules re these competitions were read and approved. It was also resolved that points be given for dealing with pests and proper use of water and that the Competitors be informed of these conditions as well.

It was decided to adopt *Mutatis mutandis* the rules observed in Kandy District last year for judging. The Divisional Agricultural Officer be asked to kindly furnish this Committee with a copy of those rules.

Vegetable Gardens Competitions :—Read rules framed by Department of Agriculture dated 10th June, 1921.

Re rule 6.—Resolved that names of Competitors, area and situation of the Gardens should be reported to the Agricultural Instructor before the end of the year and judging should be completed by end of July, 1922.

Re Rule 10.—It was decided to appoint the third Judge (an Agriculturist) by the Food Production Committee.

Prizes.—Resolved that only two prizes, a 1st prize of Rs. 20 and a 2nd prize of Rs. 10 be guaranteed for the present. It was resolved that RANHAMI of Bowatte who got the 1st prize for the best vegetable garden at the last Show will not be eligible for the competition unless he prepares a new garden for the purpose.

Decided that there should be 7 competitions for the District and that the competitions be confined to the following areas only, viz.: —

MATALE SOUTH :	(1)	Kohonsiya Pattu
	(2)	Gampahasiya Pattu
	(3)	Asgiri Udasiya and Pallesiya Pattus
	(4)	Matale Udasiya and Medasiya Pattus
MATALE NORTH :	(1)	Udugoda Udasiya and Wagapanaha Udasiya
	(2)	Udugoda Pallesiya and Kandepalle Korale
MATALE EAST :	(1)	Matale Pallesiya Pattu and Ambanganga Korale

Paddy Manuring Experimental Areas : The Divisional Agricultural Officer of the Central Division tabled a list of paddy manuring experimental areas in the Matale District. The Assistant Government Agent promised to visit the plots when possible.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For the months of September and October, 1921.

TEA.

The whole of the old Tea has been pruned. The bushes were pruned on their merits, but in the majority of cases have been cut down into the old wood. The wood in the Single jat plots (141, 142 & 143) was extremely poor, better in the Assam Indigenous plots (including the control plot) and very fair in the Manipuri plots.

Damage has been done by Tea termites and white ants in the latter case following old attacks of branch canker.

In view of the fairly heavy infection by Shot-hole Borer all prunings except the leaves and small twigs have been burnt.

Moss has been removed.

The dadaps in the ½ acre tea clearing have been lopped after an interval of 17 weeks and yielded 31 lb. of green material per tree.

The Gliricidia maculata in the same plot lately yielded 56 lb. per tree after an interval of only 11 weeks, a striking superiority of yield of green material over the dadaps.

Plot 155 has been given an application of 20 tons of fairly well rotted cattle manure.

RUBBER.

All vacancies in the New Avenue and Bandaratenne rubber areas have again been supplied. A portion of the New Avenue rubber has been interplanted with the following green manure plants, Gliricidia maculata, Leucæna Glauca, Tephrosia Candida, Crotalaria Incana, Crotalaria striata, Crotalaria Muijussi and Black gram. Other varieties are to be planted as soon as possible. Of the varieties planted in the Young Bandaratenne rubber Indigifera arrecta now forms the finest cover.

CACAO.

A systematic round of plant sanitation is being carried out and will be completed early in November.

All bark canker has been scraped, copper sulphate applied and the wounds tarred. All dead stumps are being dug up and the holes limed. Trenching has been carried out in a few cases where root disease was suspected. A large accumulation of old dadap logs has been removed by elephant. All Loranthus has again been removed. A good picking was taken early in October and another is now in progress. The crop for this year (April, 1921 to March 1922) is now 936 lb. ahead of last year's crop and prospects for the remainder of the season are good.

COCONUTS.

A picking was taken in March. The crop harvested to date is 37,887 nuts, as against 29,798 nuts to the same period in 1920.

A start has been made at forking out Illuk in the Bandaratenne coconut area, it is hoped to free a considerable portion of the area during the current financial year. Prices have been poor. At an auction sale in October Rs. 36 per 1000 for unselected nuts was the highest bid obtained.

COFFEE.

All shade has been lopped. On this occasion a certain amount of scorching of upper leaves followed the lopping. It would seem advisable during seasons of hot sun to only partially lop shade trees at one time. "Dieback" caused by Collectrotrichum Coffeanum has caused damage.

In addition to the dying back of branches from the tips the berries have in many cases been directly affected. The affected branches have been regularly pruned and burnt but this treatment has not proved sufficiently effective and a small area is now being experimentally sprayed every week with Bordeaux mixture. A dieback of the primaries has also occurred in the Young Robusta plot in the New Economic plots.

Several bushes of Canephora and Uganda coffee have been affected with a Chlorosis of the leaves. No fungoid diseases have been discovered on these specimens and it is assumed that soil conditions are responsible.

The following table shows the average yields of berries per tree of the different varieties of the Robusta types of coffee.

October 1st, 1919 to 30th Sept., 1920.		1st October, 1920 to 30th Sept., 1921.	
Robusta	1·34	Robusta	1·37
Uganda	2·06	Uganda	2·26
Quillou	2·81	Quillou	1·17
Canephora ...	1·87	Canephora ...	1·57
		Hybrid	1·21

It is intended to fork the whole coffee area in December and to apply cattle manure to part of the area.

Approximately 1½ acres of 4-year old rubber at Bandaratenne have been interplanted with coffee. Two rows each of Robusta, Hybrid, Quillou, Canephora and Arabian have been planted.

PADDY.

For the Maha season 1921 the Economic Botanist has transferred his experiments to the new paddy area. Lack of water prevented the early preparation of these fields for transplanting. Plots not required for paddy have been planted up with Lima beans, Cow peas and various green manure plants.

ECONOMIC COLLECTION PLOTS.

Several additional products have been established. A good deal of labour has been expended in eradicating sensitive weed, Illuk and other growths from the grass paths. A fresh area is being prepared for the growth of annual economic crops. This work entails the picking up and removal of the foundation stones and metal of an old road and the partial filling up of the hollow left. Considerable progress has been made with this. Another portion of this area contained a strong growth of Illuk; this has now been forked 4 times and the weed may be considered to be under control. It will be some time before the whole of this area is ready for planting.

FODDER GRASSES.

The ½ acre of Paspalum dilatatum is now being cut.

Two new grasses have been introduced. (1) Kikuya grass, Pennisetum Longistylum (2) Sudan grass.

Of the former only a small quantity of very dried up roots were received from Australia. Some of these are growing well and in time will provide material for trials on a field scale. The grass is very well spoken of in Australia.

A small quantity of Sudan grass seed was received from the Ceylon Agricultural Society and produced a vigorous growth of a large grass of erect habit. This grass is very popular in Australia where it is grown as an annual. It affords two cuttings a year of from 6 to 9 tons of grass per acre per cutting.

A portion of the original plot has been left for seed while the roots of the remainder have been divided out and replanted.

CAMPHOR.

Further distillations with a copper retort form of still have been unsuccessful though an improvement on results obtained with the old still. 54% is the highest outturn of camphor so far obtained.

A chatty still is now in the course of construction.

EXPERIMENTS WITH NITRATE OF SODA ON MINOR AGRICULTURAL CROPS.

The experiments with Cow peas and Lima beans were abandoned. Plots of Paspalum millet and Cicer gram have been included in the experiment in their place. Results will be available at the next meeting.

ROADS.

Some progress has been made with the new road bounding the Economic Plots.

Some foundation stone has been broken for metalling roads.

RAINFALL.

Rainfall for September was 2'18 inches and 11'21 for October.

T. H. HOLLAND,
Manager,
Experiment Station, Peradeniya.

AGRICULTURAL COMPETITIONS IN THE GALLE DISTRICT.

The undermentioned competitions will take place in the Galle District during 1921-22,

1.	*The Whole Galle District:*—Best plot of Paddy (6 Pattus) Transplanted or Manured in each Pattu			1st Prize		Rs. 25·00
				2nd ,,	,,	10·00
						35·00
				Total for 6 Pattus		Rs. 210·00
2.	*Four Gravets:*—Vegetable Gardens Competitions			1st Prize		Rs. 35·00
				2nd ,,	,,	20·00
				3rd ,,	,,	10·00
						65·00
3.	*Gangabeda Pattu:*—	do	do	1st ,,	,,	35·00
				2nd ,,	,,	20·00
				3rd ,,	,,	10·00
						65·00
4.	*Bentota-Wallalla-wili Korale:*—	do	do	1st ,,	,,	35·00
				2nd ,,	,,	20·00
				3rd ,,	,,	10·00
						65·00
5.	*Talpe Pattu:*—	do	do	1st ,,	,,	35·00
				2nd ,,	,,	20·00
				3rd ,,	,,	10·00
						65·00

6. *Wellaboda Pattu :—*

Vegetable Gardens	Competitions	1st	Prize	Rs.	35·00
do	do	2nd	,,	,,	20·00
do	do	3rd	,,	,,	10·00
					65·00

7. *Hinidum Pattu :—*

do	do	1st	,,	,,	35·00
do	do	2nd	,,	,,	20·00
do	do	3rd	,,	,,	10·00
					65·00

8. *Bentota-Wallallawiti-Korale & Talpe Pattu :—*

Best School Garden in these two districts	1st	,,	,,	20·00
	2nd	,,	,,	10·00
				30·00

These competitions will be conducted in accordance with the following rules :—

(1) Each competition will be confined to the District named.

(2) Competitors should give their names to the Agricultural Instructor of their district not later than the 31st December, 1921, i.e.

Four Gravets Talpe & Gangaboda Pattus	MR. GEO. SENEVIRATNE, Y.M.C.A., Fort, Galle.
Bentota-Wallallawiti Korale, Wellaboda and Hinidum Pattus.	MR. L. A. D. SILVA, Ambalangoda.

(3) Judging will be carried out during the months of January and February, 1922.

(4) Following is a list on which gardens will be judged together with the maximum number of marks for each :—

(a) General arrangement of the garden	10	Maximum.
(b) Cleanness - -	10	,,
(c) Ornamental work, hedges, etc.	15	,,
(d) Fruit section, varieties grown, etc.	10	,,
(e) Vegetable section, varieties grown, methods, etc. -	20	,,
(f) Manuring practised -	10	,,
(g) Tilth of the Soil -	15	,,
(h) Evidence of marked originality	10	,,
	100	

(5) Only *bona fide* cultivators or owners of not more than four acres and not less than ¼ acre will be allowed to compete in the Paddy Transplanted or manured plot competition.

(6) Preliminary judging will be carried out by the officers of the Agricultural Department, Southern Division.

(7) Schedule of marks given will be sent to the Divisional Agricultural Officer, Galle, immediately after the inspection has taken place.

(8) Final decision as to the award of prizes will be arrived at by the Food Production Committee of the Galle District who will consider the reports submitted and, if they deem it necessary, depute a Judging Committee.

APICULTURE.

BEE-KEEPING NOTES.

The metal (aluminium) comb, which at one time was looked upon with suspicion, is gaining popularity every year. Says the BEE WORLD, "The advantages and disadvantages of the appliance have been sufficiently discussed in the light of experience at home and abroad that, to put it modestly, it is not premature to form at least a definite opinion, though subject of course to future modification in the light of further experience. It is hardly fair to condemn the appliance without trying it, and trying it in the correct way . . . . . Every year adds more to our experience as to the most profitable methods of using the appliance and demonstrating to our advantage its superiority over the wax foundation : and meanwhile we are moving forward."

The question of adopting the metal comb for the *Apis indica* bee has been raised by one of our members : but our comb-foundation machine is scarcely likely to serve us. as it is intended for working only with wax. The Secretary of the Association is, however, consulting "A. I. ROOT," who made the machine for us, on the subject.

In uniting bees Mr. J. B. LAMB (Chairman, Middlesex Bee-keepers' Association) advises that the bees of the stronger colony should be thrown before the entrance of the weaker, so that their over-powering numbers will ensure their admission without much fighting : if *vice versa*, there is sure to be much slaughter. Popular means of preventing hostilities are to (1) shake the two lots of bees on a wide alighting board before the hive, and sprinkle them with flour, (2) syringe both lots with some strong smelling liquid, (3) place for an hour or two in both colonies to be united slices of onion, so as to cause each stock to acquire the same odour.

At the Government Stock Garden some months ago when the weather was excessively wet, there was a good deal of bee mortality which could not be accounted for except in the presumption that it was due to some form of epidemic disease. In this connection it is interesting to read in a report made by DR. ROCHA D'AMORIN of a similar mortality in North Portugal, which he says is practically free from disease. He is inclined to attribute the mortality to defective alimentation, the nectar or pollen being altered by excessive humidity which prevailed. In such circumstances artificial feeding with thin syrup is recommended.

"The life of a bee is not measured in time but in work accomplished ; so should it be with man."

The Leaflet entitled "Hints to Beginners in Bee-keeping" is now available both in Sinhalese and Tamil—on application to the Secretary.

A well-known writer on apiculture says: Bee-keeping can hardly be called an exact science. A good knowledge of the habits of bees is necessary to successful management, but to secure the best results much will depend on the good judgment of the bee-keeper as to the best way to treat each colony. We must become so well acquainted with our bees by association with them, that we can recognise their various moods and actions as well as we do those of people with whom we associate. We must remain novices in the business of bee-keeping until we can catch what is called "The spirit of the hive."

The crushing of bees by a careless worker is a frequent cause of bee-stings. One bee accidentally crushed is sufficient to disturb the equilibrium of the hive, and make the bees wild. If a bee should be crushed in spite of careful handling, it is advisable to hold the nozzle of the smoker close to the injured bee and give a few strong puffs of smoke to neutralize the odour which acts as a sort of danger signal.

The Association is indebted to MR HERBERT CAMPBELL, late of Nuwara Eliya, and one of the pioneers of bee-keeping in Ceylon, for an introduction to the Apis Club, whose headquarters are Port Hill House, Benson, Oxon, England. MR. CAMPBELL is now at Cookham Dean. The Magazine of the Apis Club is the BEE WORLD (edited by MR. A. Z. ABUSHADY, who is also the Secretary of the Club) which is regularly received by the Association and contains very valuable information to Bee-keepers. Another publication received is GLEANINGS IN BEE CULTURE, published in America.

There is an impression among some people that Ceylon bees are not sufficiently educated to avoid poisonous flowers, and, therefore, that the honey they gather is not wholesome. The poet KEATS says:—

"Even bees, the little almsmen of spring bowers
Know there is richest juice in poison-flowers"

but the changes which the nectar of flowers passes through before it becomes honey should provide against any possibility of anyone being poisoned by consuming the product of the hive, as bees are scarcely likely to provide for themselves sustenance that carries self destruction.

What is unfortunate, however, is that much of our honey is tainted, at particular seasons, owing to its being gathered from flowers the nectar of which has a bitter flavour. This is especially the case during the flowering season of rubber (*Hevea Brasiliensis*), but the blossom of Manioc or Cassava is also objectionable for the same reason. The honey from Australia at one time carried the flavour of Eucalyptus flowers, but this appears to be less marked now-a-days. Is there any means by which evil flavours could be "filtered" out?

MR. H. S. STEVENS, one of our foundation members, who was of considerable assistance to this Association in its early days, last wrote from Torquay, where he was carrying on bee-keeping.

Lima Beans, which are coming to be cultivated fairly extensively in the Island, is a good source of honey. For honey production they should be planted continuously, as if planted all at once the honey flow only lasts a week or 10 days. When well capped and ripened lima bean honey has a rich flavour.

The Editor of a bee-keeper's Journal in Japan has some interesting information to give as to how they overcame difficulties in that country. He says that the bee-keepers of the northern Island habitually migrate to the southern district, covering no less than 2,000 miles with their bees. In January rape flowers in the South while the North is covered with snow. In May the wanderers return with increase in bees and cans of surplus honey. There is but one flow (a big one) in most parts of Japan, and then a long drought. The principal flow comes from *Astragalus sinicus* which is cultivated in the rice fields and blossoms from the end of April for a month. It is then cut for green manure for the rice.

C. D.

THE DUTCH BEE.

Dutch bees have not enjoyed a reputation to be proud of: being generally considered to be good for re-stocking but useless as a source of profit. They are specially condemned for their swarming propensities and bad temper. But the Rev. E. F. HEMMING, whose opinion is worth having, considers them excellent workers if judiciously handled. Their swarming habit is attributed chiefly to their being such furious workers, but given ample room they will not think of swarming till they have occupied it and made 30 or 40 lb. of surplus honey. MR. HEMMING advises that such room should be provided on the floor level of the hive and not in the super. He has had them filling 9 or 10 frames within a week during the flow, says MR. HEMMING. "Extend your hive lengthways if you can, or get one made to take about 25 frames placed parallel to the entrance with the queen excluder placed between the 10th and 11th frame. As a comb is filled with honey take it out and return or put in an empty one. Under these circumstances there should not be more than one swarm in a season."

THE BEE WORLD does not agree with the suggestion of limiting the usefulness of the Dutch bee to extended hives.

The Agent for the best known and largest bee-keeper in Holland (Hans Malthes) is R. WHYTE, Orme Lodge Apiary, Cumbernauld, Dumbartonshire.

C. D.

CO-OPERATION.

CO-OPERATIVE SOCIETIES ORDINANCE: No. 34 OF 1921.

CO-OPERATION LEAFLET, No. 5, DEPARTMENT OF AGRICULTURE, CEYLON.

The Co-operative Credit Societies Ordinance, No. 7 of 1911, has been repealed and replaced by Ordinance No. 34 of 1921, which came into operation with effect from September 22, 1921. The important changes effected by the new Ordinance are herein outlined, and should be noted by co-operative workers. From September 22, 1921, the work of societies should be carried on in accordance with the provisions of the new Ordinance.

Section 42 of the new Ordinance conserves the validity (1) of the registration of societies already registered under Ordinance No. 7 of 1911; and (2) of the existing by-laws of such societies which are not inconsistent with the express provisions of the new Ordinance. If the by-laws of any society infringe the provisions of this Ordinance, the Committee of every society should take steps immediately to rectify its by-laws so that they may be in conformity with the new Ordinance.

At the outset it is to be noted that the title of the Ordinance has been altered to "Co-operative Societies," from "Co-operative Credit Societies." The omission of the word "Credit" enables societies to engage in other business on co-operative principles than the mere taking or giving of loans. Therefore, under the new Ordinance, co-operative organizations can be formed for the purpose of production, distribution, purchase and sale, for building purposes, cattle insurance, etc.

Section 3 makes provision for the appointment of Assistants to the registrar with or without the full powers of the Registrar. Their powers and duties may be defined by general or special order published in the *Government Gazette*. In the repealed Ordinance there was no provision for the appointment of Assistant Registrars.

Section 4 defines the nature of the societies which may be registered under the Ordinance, viz., any society which has as its objects the promotion of the economic interests of its numbers in accordance with co-operative principles or any society established for the purpose of facilitating the operations of such societies. Thus, this section enlarges the scope of the movement, and provides for the registration of primary societies, union, central banks etc.

Section 5 extends the privilege of admission to membership to those who, though living outside the area of operations, own landed property therein.

Section 6 includes provision for the registration of central banks and unions. Application for registration has to be made (1) in the case of primary societies by at least ten persons; (2) in the case of central banks or

unions by authorized persons of at least two registered societies. A copy of the proposed by-laws of the society must accompany the application.

Section 8 provides that a certificate of registration signed by the Registrar is conclusive evidence of the registration of a society, unless it is proved that the registration has been cancelled.

Section 9 provides that an amendment of a by-law shall not be valid until it is registered by the Registrar. A copy of the amended by-law certified by the Registrar is conclusive evidence of its registration.

Section 11 prohibits a person from becoming a member of more than one society without obtaining written sanction of the Registrar. This does not effect a registered society becoming a member of more than one central society.

Section 12 provides that in case of societies with unlimited liability no member shall have more than one vote, and in case of societies with limited liability the number of votes a member is entitled to possess shall be prescribed by by-laws. It also provides for the appointment of proxies to represent a society in another society.

Section 14 requires every society to notify change of registered address of a society to the Registrar.

Section 15 requires every society to keep a copy of the Ordinance, rules, and certified by-laws of the society at its registered address for inspection at any reasonable time.

Section 16 authorizes the Registrar or any person authorized by him to audit accounts of societies at least once in every year.

Section 18 makes provision to enforce priority of claims of the society against its members on their crops, agricultural produce, articles manufactured from raw materials supplied or purchased with the money lent, within a period of two years (as against one year in the old Ordinance).

Section 21 provides that on the death of a member the society may transfer his share or interest or pay its value thereof to his nominee or heir or legal representative, who, if the society is of unlimited liability, is entitled to claim payment of value instead of transfers. Transfers and payments made in accordance with the Ordinance are valid against any other demand.

Under sections 22 and 23 the liability of the past member and the estate of the deceased member of society, respectively, for the debts of the society is extended to two years.

Section 24 provides that the register of members shall be *prima facie* evidence of the date on which the membership of a person in a society began or ended.

Section 30 makes provision for a society to invest its funds in shares in another society. Thus, a primary society is now able to purchase shares in a central bank.

Section 31, sub-section (1), makes provision for the distribution of three-fourths of the total annual nett profits to members, subject to the rules and by-laws, after one-fourth of the profits has been carried to a reserve fund. No society with unlimited liability is allowed to distribute any profits without the written sanction of the Registrar.

Section 34 gives power to the Registrar to cancel the registration of a society other than a central bank when the membership falls below ten persons.

Section 37, sub-section (3), makes provision for the making of rules by the Governor in Executive Council, and these will be laid before the Legislative Council, which within 40 days therefrom has power to disallow, amend, or deal otherwise with such rules.

Section 40 prohibits, on pain of criminal prosecution and punishment, the use of the word "co-operative" by any person other than a registered co-operative society in any business under any name or title of which the

word " co-operative " is part without the sanction of the Governor in Executive Council. This section does not, however, apply to any existing business which has used the word "co-operative" before the Ordinance came into force.

RULES.

The new rules are made under section 37 (2) of the new Ordinance, and the important changes are the following :—

Where capital is not to be raised by the issue of shares, a person may pay in respect of membership an amount of not less than Re. 1. New societies with unlimited liability may raise their capital in this manner.

Application for registration of a society may now be forwarded to the Registrar through an Assistant Government Agent as well.

In the case formation of a central bank or a union, the application for registration may be signed by two persons representing two societies.

Members guilty of wrongful application of loans or other conduct prejudicial to the interest of a society are liable for punishment by suspension or expulsion. Expelled members are entitled only to sums of money standing to their credit. When a member ceases to be a member by withdrawal or death, such member or his nominee in the case of death is entitled to receive any bonuses declared at the next following general meeting.

No portion of the reserve fund can be claimed by a past member or the nominee of a deceased member.

Members are empowered to cancel the names of nominees, in the case of their death or otherwise, and substitute names of fresh nominees.

A dividend or payment on account of profits shall not be made by a society registered with unlimited liability, until the reserve fund has reached a proportion of not less than one-tenth of its total liabilities, and unless the rate of interest on loans to members is 12 per cent. per annum or less.

No dividend or payment of the bonuses shall exceed 9 per cent. per annum. Rate of interest on deposits shall not exceed three-fourths of the rate of loans given by the society, and the maximum rate that can be paid on deposits is 9 per cent. per annum.

The maximum amount that a society with unlimited liability can borrow ordinarily from other than members is three times the paid-up capital, deposits of members, and reserve fund, and a society with limited liability, without the deposit of collateral security, only an amount equal to the paid-up capital, deposits of members, and reserve fund.

Among other things, a society is now empowered to frame by-laws to levy fines on members. The quorum required for a general meeting for a society with unlimited liability to amend, alter, or rescind a by-law is one-half of the members. Three-fourths of the votes of the members will carry the resolution. In the case of a society with limited liability, the written votes of a majority of not less than three-fourths of members are necessary if a poll is demanded.

All by-laws and amendments must be sent to reach the Registrar within fourteen days of their having been passed by the society.

The provision for the delegation of power to the Committee to frame by-laws in respect of certain matters has been repealed. The society alone is now entitled to frame by-laws which are not valid till they are registered by the Registrar.

The financial year of all co-operative societies is now May 1 to April 30.

The annual statement of accounts, consisting of receipts, disbursements, profit and loss, and assets and liabilities, should be sent to the Registrar before July 1 every year. The societies must publish them before May 31 each year. There are thus two months, May and June, within which period the societies should be inspected for annual audit.

Particulars of forms and books to be kept by a credit society, a central bank, a distributive or productive society are given.

The restriction on a society from receiving a Government loan when the society is already in receipt of a Government loan has been removed in the new rules.

The societies are requested to obtain copies of the new Ordinance for careful perusal by all members.

F. A. STOCKDALE,
Registrar, Co-operative Societies.

Peradeniya, October 10, 1921.

KARAVEDDI CO-OPERATIVE CREDIT SOCIETY.

Karaveddi is a sub-division of the Chief Headman's division of Vadamaradchi West in the District of Jaffna in the Northern Province. The villagers are all agriculturists. In 1916 a Co-operative Credit Society was started under the presidency of the Chief Headman Maniagar Chinnatamby with a membership of 40. At the end of the first financial year the membership of the Society rose to 78 and the paid up capital to Rs. 731·00. The Society has worked for nearly five years and the progress during the period is satisfactory.

At the end of 1920-21 it had 170 members and Rs. 1,465·50 as paid up capital and the Reserve Fund was Rs. 38·15. The Society has given Rs. 2,684 on loan to members during the year and recovered Rs. 2,079 00. The amount oustanding at the end of the year was Rs. 25·39. In this respect the following figures will be of some interest. In 1917 loans given were Rs. 909·00 ; recovered Rs. 90·00 ; in 1918 loans given Rs. 1,795·00 and recovered Rs. 1,355·00 ; in 1919 Rs. 1,685·00 was lent and Rs. 1,555·00 recovered and in 1920 Rs. 2,094·00 was lent and Rs. 1,645·00 recovered, and the amount outstanding was Rs 1,934·00. From the above figures it will be seen that the business of the Society has increased year after year. This is not all. The Society has taken an interest in the encouragement of thrift among members also by inducing them to make deposits. Members have deposited with the Society their small savings. The following figures will show the gradual increase of deposits ; In 1917, the deposits were Rs. 105 50. In the second year it rose to Rs. 308·75. During the two succeeding years the deposits have increased to Rs. 382·00 and Rs. 495·00 respectively, and at the end of this year the deposits to the credit of 34 members stood at Rs. 717·90. The Society should endeavour to induce all the members to cultivate the habit of saving out of their earnings and deposit such savings in the Society. Hitherto the Society has had dealing with their own money and they have had no occasion to go outside the Society for funds. As the membership increases the funds at the disposal of the Society should also increase as it is only then that the demand of the members can be met. Members themselves should also endeavour to increase their business capacity.

The nominal capital of the Society is Rs. 2,500·00 and the members should see that this amount is collected before long.

The President of the Society is taking a keen interest in the Society. The Secretary MR. S. SABAPATHIPILLAI has been elected Secretary of the Society year after year. This indicates the confidence the members have in him and also his interest in the Society. The Committee has been helping the President to achieve these results and it is hoped that they will continue to do so until the Society achieves its objects.

N. W.

GENERAL.

FLOWERING OF PLANTS AND THE LENGTH OF DAY.

The following is an extract from an article on the above subject by W. W. GUNNER and H. A. ALLAND in the U. S. Dept. of Agriculture Year Book for 1920 :—

A correct interpretation of the effects of length of day upon the plants will be a great aid in reaching a better understanding of the causes which limit the natural habitat of most plants, a problem which has been a difficult one to solve. To the farmer, the facts which have been established will strongly emphasize the importance of accurately knowing the correct season for planting each of his crops in order to secure the highest returns. Under some conditions a difference of no more than 10 days in time of planting would definitely direct the plant's activities toward either the purely vegetative or the reproductive form of development, as the case may be. Now, in one case the farmer may be chiefly concerned with extensive vegetative growth, while in another he may be interested primarily in flower, fruit, or seed development. Of course, much has already been learned empirically as to the proper time of planting various crops, but recognition of the importance of the relative lengths of day and night as a factor in a measure reopens the questions.

The plant breeder should be able to gain a better insight into some of his problems, such as securing for any particular region earlier or later varieties, more faithful or larger growing forms, and improved everbloomers and everbearers. In the same way the problem of extending the northern or southern ranges of crop plants may be more clearly defined. In many cases breeding work can be hastened through artificial control of light duration, which will make it possible to work more or less independently of natural conditions of day length, both as to time of year and as to geographical location of the worker. It often happens that plant breeders are unable to make crosses between certain plants because of differences in time of flowering of the two parental types. In such instances artificial control of the daily light period should be of great value for in this way the date of flowering can be accurately controlled. The plant introducer will have at his command a more adequate basis for analyzing the factors which determine whether any particular plant is adapted to a new region. Moreover, in special cases it may be possible to introduce successfully new plants through artificial control of light conditions or by taking fuller advantage of seasonal differences in length of day.

Within suitable limits of temperature and other important factors in growth, there would seem to be no reason why almost any plant may not be made to flower and fruit at any season of the year and in any region. By shortening the daily light period through the use of dark chambers or lengthening it by means of artificial light, reproductive activities may be induced almost at will. With proper knowledge of the specific requirements of each plant, therefore, the florist should be able to force flowering at any desired time of the year. It has been possible to secure excellent flowering specimens of iris in midwinter and chrysanthemum, poinsettia, and other plants in summer by utilizing these principles. In the same way wild violets have been kept in the everblooming stage as long as 9 months. The principles involved are so simple that anyone interested in plants can easily obtain instructive and convincing results.

In conclusion, it may be of interest to cite a specific instance in which the day-length effect has been applied to the solution of a practical problem in tobacco culture. Several years ago a new type of tobacco was discovered in southern Maryland. Under suitable conditions this type grows to an unusually large size, the plant in some cases producing more than 100 leaves; hence the name Maryland Mammoth by which this variety is known. Because of its high yielding capacity this variety has been grown with great success in Southern Maryland. An excellent crop of Mammoth tobacco is shown in figure 9. A peculiarity of this tobacco is that either it does not flower at all in the field in Maryland or flowering occurs so late in the season that the seed does not mature. Farmers, therefore, cannot obtain seed by the usual methods. It was found, however, that Mammoth tobacco flowers very readily in the greenhouse under the natural day length of winter, whereas artificial lengthening of the daily light period of winter prevents flowering, as shown in figure 9. The plant does not flower in the field in Maryland, because the summer days are too long. The problem of securing seed is easily met by growing the plant in southern Florida during the winter, for under these conditions the Mammoth flowers and fruits are much the same as the ordinary varieties of tobacco.

CASUARINA TOPES.

It is an admitted fact that there is now an acute scarcity of fuel on the West Coast and a hue and cry is momentarily raised and the market cursed for the high prices paid for the scarce supply provided by generous nature. But no serious attempts are made to supplement this gradually diminishing supply by human efforts and on the other hand, the available supply of cow-dung is substituted for fuel with the doubly disastrous result that this valuable manure also is becoming insufficient for its legitimate purposes. It is high time that the ruralist should realise the situation fully and rise to the occasion by paying special attention to the growing of forest trees with a view to provide himself and the market against this scarcity. Of course great care and judgment are needed in the selection of particular kinds of trees to be planted for the purpose and the ryot should be wise enough to choose only such varieties as would meet his personal wants in the shortest time possible and those of the market in course of time, for a good consideration. So far, Casuarina topes seem to be best suited for the above purpose and these can be grown on any dry land unfit for cultivation, without much trouble and care. Their loppings can be constantly made use of from the sale of the tope itself in the end. Our arboriculturalal speculators without looking for immediate and large profits from such investments have to patiently wait for some time, in the meanwhile satisfying themselves with what little they get out of them for their personal requirements. The following hints would be useful to any one who may move in the direction of raising Casuarina topes in his own interests and in the interests of the public as well.

Casuarina equisetifolia.—Of the several species introduced from Australia, the one under notice has alone been familiar in India. This is also called the Tinian or beefwood tree. The soft sighing of the air agreeable and well-known sound, reminds one of the distant sea washing upon the shore. It is unsuited to the garden, except as a hedge, on account of the needlelike leaves constantly falling.

Soil.—Casuarina attains great perfection in a loose sandy soil near the sea. It also thrives well on upland tracts of hard loam in the interior where the growth is rather slow. But the trees grown on loams become stouter and stronger.

Propagation :—Ripe fruits from old trees are gathered in the hot weather, put in earthern pots and kept in the sun. The fruits burst and the seeds are then carefully dried and stored. Twelve ounces of seed sown on 100 sq. feet will supply seedlings sufficient to transplant one acre. The seed is sprinkled evenly on the surface of the nursery and covered thinly with ashes and cattle manure. The plot is then covered with straw, leaves, etc. and regularly watered. The seeds sprout in 8-10 days. Caro should be transplanted in another nursery and they are finally removed for planting in the field in 6 or 8 months when they are less than 3 feet high.

Planting.—3000-4000 small pits are dug 4 or 5 inches apart with a mamotie in an acre of ground, kept exposed for a time and then hand-watered just before planting. The pits are not manured, and the plants should be watered till they take root, and then they can be watered once a week during the first year or in exceptional cases for two hot weather seasons. On the west Coast, if the transplanting is done immediately after the rains set in, there is not the necessity of watering the plants at all. The plants establish themselves before the close of the monsoon and during the two hot months of the following hot season, watering once a week or two may be useful and may accelerate the growth. But there will not be much harm if watering is dispensed with. The plantation should be thinned and all crooked plants removed, leaving 1,500 plants for an acre.

Manuring.—If the investor wants to reap larger profits within a short time, he will have to feed his plants to a certain extent. During the year of transplanting, a handful of wood ashes should be applied to each tree in October, loosening the soil in the pit. During the second or third year 3 cwt. of fish guano or a cwt. of nitrate of soda, well mixed with wood ashes, should be applied and this can be repeated every second or third year. The tope will be ready for sale at the end of ten or twelve years and each tree will on an average fetch 0-8-0 and if well fed over a rupee.

The following estimates will give a brief idea as to the cost to be incurred in the course of ten years towards maintaining a ten-acre plot for the casuarina tope.

Revenue to be paid to Govt. @ Rs. 10 a year	...	Rs. 100
Fencing and walling ...	...	,, 100
The price of 15,000 seedings @ Rs. 8 per 1,000	...	,, 120
Cost towards pits and planting ...	...	,, 150
Cost towards watering and during five seasons in the course of the ten years ...	...	,, 250
	Total	Rs. 720

Or in round figures Rs. 800 will be required for the maintenance of a casuarina tope of the above extent. In the intervening years the proceeds of the loppings from the side-branches, etc. will defray all expenses of watering and manuring. Further, after the plantation is out, about 50% of the roots will put forth fresh shoots, and the ratoon plantation will also be ready for cutting in ten years.—N. S. W.—

INDIAN SCIENTIFIC AGRICULTURIST, Vol. 8, No. 5.

MULCHING.

F. GORDON.

The beneficial effects of mulching are now generally known, but it is seldom that the operation has been of greater service than during the hot dry season. Last autumn I was called in to advise on the planting of two young orchards only a few miles apart. The trees were obtained from the

same nursery, and all were planted in December, the work being well done. Early in March I advised the mulching of these trees in one orchard, and the work was carried out at once, with the result that all the trees lived and have made a little healthy growth, and are now able to hold their own. In the second case, mulching was deferred until the middle of last month, too late to save many of the trees, which are now almost leafless, and otherwise too weak, to overcome the attacks of numerous insect enemies. Planters often neglect to use manure for trees and shrubs, but a light mulching of half-rotted manure has given most satisfactory results this season, especially where little or no water was at hand. Roots of newly-planted trees are not in a condition to assimilate stimulants, and rich manure should not be used, yet a covering of some material that will prevent surface evaporation and absorb the sun's heat should be placed over the newly-disturbed ground before the end of the first quarter of the year. Heavy animal manure may be tolerated on light, warm soils, but for heavy land, lime rubble, burnt earth and refuse from the rubbish heap are preferable. An excellent and clean substitute for manure in large or small gardens is Wakeley's hop manure. Established trees from which good crops of fruit are expected require stimulants from the time the fruits commence to swell until they are nearly ripe, hence the advantage of covering the borders, and especially those at the foot of south walls, with material as a mulch. Fresh stable manure is very suitable to use as a mulch for stone fruits planted against south walls, as it charges the dry, warm surface with ammonia, and acts as a beneficial stimulant on the foliage.

The present tropical summer has caught procrastinating mulchers napping, and their crops have suffered. Fruits, including vines, Figs, and all stone fruits grown under glass require practically the same treatment, both as to the time of application and the quality of the mulching. Old Peach trees and vines which crop freely and do not make strong wood, derive great benefit from frequent waterings with diluted liquid during the autumn. All gardeners who force extensively know the value of fresh unfermented stable manure, and make good use of it when their crops of Grapes, Peaches, etc., are swelling, more so than the growers of hardy fruits, who prefer it in a state of decomposition. The best time to apply it is immediately after the crops of fruit are set, and here a word of warning may be useful to the inexperienced. Too much ammonia in a close, hot house may soon do more harm than good ; indeed, so subtle is an overdose all the tender foliage may be destroyed in a few minutes. By spreading the material in the frame ground and turning it on one or two occasions, also by watering with clear water and allowing the dung to get dry in the open, this useful material will be quite safe for use as a mulch beneath most tender foliage, always provided a little air is admitted through the roof ventilators night and day after the borders are mulched. The same remarks apply to nearly all kinds of vegetables, for without mulching of various kinds the gardener could not carry his crops to the highest state of perfection. If liberal mulching were practised when planting on poor soils there would be fewer reports of failures and losses. Those who succeed best always were on the side of moderation, both in strength and quantity of the mulch, and in making repeated applications from the time the crops are set until they approach maturity. There is need, also, to remove the mulching material at the end of the season, for to retain it when rains are frequent and the power of the sun small, would mean that the soil would be kept unnecessarily cold and wet. Air, too, would be excluded and the ground generally get in a sour, soddened condition.—GARDENERS' CHRONICLE, Vol. LXX, No. 1803.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th NOVEMBER, 1921.

Province, &c.	Disease.	No. of Cases up to date since Jan. 1st. 1921.	Fresh Cases	Recoveries.	Deaths.	Balance Ill.	No. Shot.
Western	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	84	1	84	—	—	—
	Anthrax	—	—	—	—	—	—
Colombo Municipality	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	91	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Rabies	2	—	—	—	—	—
Cattle Quarantine Station	Rinderpest	29	22	—	—	—	—
	Foot-and-mouth disease	54*	3	—	—	—	...
	Anthrax	363†	16	—	—	—	...
Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	14	—	14	—	—	—
	Anthrax	—	—	—	—	—	—
	Piroplasmosis	19	4	10	7	2	—
Southern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	35	—	35	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest Foot-and-mouth disease Anthrax	Free					
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	245	—	236	9	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	36	—	11	23	—	2
	Foot-and-mouth disease	49	49	—	—	49	—
	Anthrax	—	—	—	—	—	—
North-Central	Rinderpest Foot-and-mouth disease Anthrax	Free					
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	430	28	392	10	28	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	20	—	2	18	—	—
Sabaragamuwa	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	49	7	42	—	7	—
	Anthrax	—	—	—	—	—	—

* 7 cases occurred amongst sheep and goats. † occurred amongst sheep and goats.

G. W. STURGESS,
Government Veterinary Surgeon.

Colombo, 6th December, 1921.

METEOROLOGICAL.

NOVEMBER, 1921.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of cloud 0=clear. 10=overcast	Mean Wind Direction during month	Daily Mean Velocity.	Rainfall: Amount	Rainfall: No. of Rainy days.	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	80·6	+ 1·0	76	5·3	N	116	3·46	14	- 7·60
Puttalam	79·3	+ 0·1	78	5·0	NE	123	4·44	14	- 5·75
Mannar	79·9	- 0·5	76	6·4	NNE	179	8·44	14	- 2·01
Jaffna	78·5	- 0·9	80	5·2	Variable	116	14·02	18	- 0·80
Trincomalee	79·0	- 1·1	84	7·8	NNE	147	11·84	20	- 2·17
Batticaloa	78·9	- 0·7	—	—	—	—	8·71	16	- 4·57
Hambantota	79·6	0	82	5·2	Variable	227	5·14	13	- 1·55
Galle	79·5	+ 0·3	82	5·4	NW	142	6·70	15	- 4·71
Ratnapura	80·7	+ 0·8	78	6·6	—	—	10·51	18	- 3·76
Anu'pura	78·1	- 0·7	81	7·1	—	—	8·35	18	- 2·24
Kurunegala	79·2	- 0·3	78	5·5	—	—	4·39	10	- 7·16
Kandy	73·5	+ 0·1	80	6·4	—	—	6·69	13	- 3·98
Badulla	71·6	- 1·0	84	7·6	—	—	6·82	26	- 3·79
Diyatalawa	65·9	- 1·1	82	6·9	—	—	6·26	23	3·50
Hakgala	59·2	- 0·4	92	8·5	—	—	10.28	21	- 1·01
N. Eliya	59·8	+ 0·7	84	7·5	—	—	5·19	18	- 3·85

In November more than in most other months Ceylon is liable to be visited by mild cyclonic depressions. This year, unlike 1920 and the majority of recent years, the visit has been omitted: a distinct menace on the 6th failed to materialise or rather materialised further East.

Rainfall totals were consequently low for this month, and in many places, notably in the North-Western Province, were the lowest on record for November.

Thus Horakelle in recording 2·03 inches ties with its previous lowest-over forty years ago—in 1876 and gauges in that neighbourhood that have only been in action a dozen years or so have almost all broken their own previous record for a dry November (e. g. Karukkua, Madurankuly, etc.).

Deficits of more than ten inches below the average were common in the northern part of the Kelani Valley and in the area northward to Kurunegala and eastward to Gampola, while deficits of over 5 ins. were found in most of the North-Western Province.

The chief areas that reached their average were the southern part of the Northern Province including Murungan and Vavuniya and extending to the East coast, and part of the Southern Province including Urubokka, Denagama, and Tangalle. A few other stations were sufficiently infrequent and scattered to be mentioned individually e.g., Pelmadulla, Ledgerwatta, (Badulla) Buttala and Panawa (S. E. coast).

Like the rainfall, the mean humidity was decidedly below normal, while the amount of cloud was slightly above it. The noteworthy absence of a depression shows in the other measurements, notably the barometer in which all stations were above average and, it may be added, the gradient was a trifle steeper than usual and hence the wind velocities higher too. In the table above the column of temperature offsets is noteworthy: these, it will be seen, are about equally divided above and below normal, whereas such consistently low rainfall would in most months of the year have been associated with consistently high temperatures.

The lowest temperature in air at Nuwara Eliya was 34·90 F and the minimum on grass at that station got below freezing point twice.

A. J. BAMFORD.